WSR-88D HANDBOOK
VOLUME 1, RPG

OPERATOR HANDBOOK

GUIDANCE ON ADAPTABLE PARAMETERS

DOPPLER METEOROLOGICAL RADAR WSR-88D

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1 AUGUST 1998

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Preface

The WSR-88D radar is a highly complex, computerized radar system. The system includes thousands of adaptable parameters which allow the required operational, geographical, and meteorological flexibility needed to support the varied missions of the three Principal User Agencies.

With over 11,000 adaptable parameters available within the WSR-88D unit, centralized control over many of the system and meteorological parameters is required to ensure a baseline operational standard is met in support of the national radar network. However, many parameters were designed to fine-tune the WSR-88D for local operational needs. Therefore, Federal Meteorological Handbook Number 11 (FMH-11) has defined three Levels of Change Authority (LOCA) for adaptable parameter control. The hierarchy established by these LOCA was defined to ensure that authority for change is based on expertise and scope of impact while still allowing for operational flexibility.

The rapidly changing nature of the WSR-88D program necessitated the publication of an easily updatable, comprehensive document to describe, define, and provide guidance for adaptable parameters under the purview of each LOCA. To address this need, the specific parameters under each LOCA are defined in the WSR-88D Guidance on Adaptable Parameters Handbook series. The authority for the adaptable parameter baseline settings and LOCA defined in this publication series resides in FMH-11.

The WSR-88D Guidance on Adaptable Parameters Handbook series was designed for operational use by field personnel and system managers, and as supplemental materials for agency training developers. To fill this broad design mandate, the adaptable parameters handbook series is divided into three separate volumes: one each for the RPG, PUP, and RDA functional areas. Each volume addresses only those parameters applicable to, and accessible through that specific component of the WSR-88D system. The appropriate screen where the adaptable parameter can be changed is shown. Additionally, for each adaptable parameter, the specific LOCA and any relevant information available is provided. As a baseline document, this handbook should be kept in a location that is easily accessible to operators and system managers. It is recommended that site specific adaptation changes be documented and posted to the appropriate section of this handbook.

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Chapter 1
Overview

1.1 Introduction

The WSR-88D system was designed such that modifications to the hardware and software operating characteristics can be made through changes in adaptable parameter settings. These changes allow for system optimization based on meteorological, climatological, and regional variations, as well as user preferences.

Recognizing the rapidly changing operational environment and the Federal Meteorological Handbook Number 11 (FMH-11) update cycle, the Doppler Radar Meteorological Observations Working Group (DRMO-WG) chairman initiated the development of more responsive and user oriented adaptable parameters guidance documents. The WSR-88D Guidance on Adaptable Parameters Handbook Series, RPG, RDA and PUP, documents were designed to meet these requirements.

1.2 Policy

As mandated by the DRMO-WG, the WSR-88D Guidance on Adaptable Parameters Handbook, RPG has primacy in the area of RPG adaptable parameter guidance and supersedes all other adaptable parameter guidance, memos, and pamphlets issued prior to its publication. This handbook may be supplemented by agency or regional memoranda to clarify policy pertaining to parameters under Unit Radar Committee (URC) and Agency level of authority.

This document, as directed by FMH-11, Part A, serves to identify the specific adaptable parameters that fall under each Level of Change Authority (LOCA). It also defines the Radar Product Generator (RPG) system baseline adaptable parameter settings required to support the national radar network and provides guidance on certain URC and Agency level parameter changes, including parameter impacts and implications.

1.3 Levels of Change Authority (LOCA) Philosophy

A hierarchy has been established to ensure maximum flexibility while maintaining data and operational integrity of the WSR-88D units throughout the nation. This hierarchy is divided into three distinct levels: Operational Support Facility (OSF) to address engineering, meteorological, and scientific parameters, Unit Radar Committee (URC) for changes that only affect the operation of their particular WSR-88D unit, and Agency to control parameters that only affect local operations. Each level controls those engineering, operational, and meteorological parameters that best apply to its level of expertise and responsibility.

The definition for each level of change authority is provided in Chapter 2. Additionally, Chapter 2 lists each RPG adaptable parameter designated with a LOCA of URC or Agency and provides a cross-reference location into the appropriate chapter and section.

1.4 Document Design Characteristics

The “WSR-88D Guidance on Adaptable Parameters Handbook, Volume I, RPG” is designed to facilitate ease of use. The volume is divided into chapters, and each chapter is further subdivided into sections. Each major adaptable parameter subject area is addressed in an individual section. For example, the meteorological algorithms subject area is subdivided into 17 individual sections. Additionally, the page numbering for the document is not sequential throughout the document, but rather the page number identifies the chapter and page sequence within the chapter (i.e., the third chapter, fourth page is numbered 3-4).

For presentation in this document, the RPG adaptable parameters were divided into four groupings; Performance Optimization Parameters, Product Parameter Control, Communications Control, and Meteorological Algorithm Parameters. Each group is addressed in an individual chapter. The sections within each chapter are arranged in the same order as presented at the Unit Control Position (UCP). These sections provide an exact copy of the appropriate UCP screen showing each adaptable parameter accessible through the applications software. The baseline adaptable parameter settings are provided for reference.

1.4.1 Highlighting URC and Agency LOCA Parameters

All adaptable parameters, unless explicitly defined as URC or Agency LOCA in Chapter 2 of this document, or changes or updates to this document, are under the OSF LOCA.

In all subsequent chapters, adaptable parameters under the URC or Agency LOCA are highlighted in one of two ways:

In the case where every parameter addressed within a given section is under the URC or Agency LOCA, the appropriate LOCA is provided in the Section Title (e.g., **3.2 Alert Processing - URC LOCA**).

When only selected adaptable parameters within a section are under the URC or Agency LOCA, the specific parameters are outlined by a box (See Figure 1.4-1).

```
                            PRECIPITATION DETECTION               PAGE  1 OF  1
COMMAND: AD,*****,M,*****,P,
FEEDBACK:                                                           OPER A/

      (M)odify, {LINE#}   (E)nd     (C)ancel   (D)elete, {LINE#}

                      Precip     Nominal     Precip
                       Rate      Clutter      Area
          Tilt        Thresh      Area       Thresh       Precip
 N       Domain        (dBR)      (Km2)       (Km2)         Cat.
------------------------------------------------------------------

------------------------------------------------------------------
 1       0.0     2.0      -2.0          80          20           2
 2       0.0     4.0       4.0         150          10           1
 3       2.0     4.0      -2.0          80          20           2
```

Figure 1.4-1 Example of Highlighted Adaptable Parameter Values

1.4.2 Supplemental Information

When information is available concerning possible impacts that changes to these parameters will have on the system or algorithm performance, a brief explanation is provided. If additional references are available, pertinent papers and articles are cross-referenced.

1.5 Adaptable Parameter Change Process

1.5.1 Urgent Changes to OSF Controlled Adaptation Data Values

Under certain conditions in order to best support local warning and forecast capabilities, individual sites may need to quickly change the value of site-specific parameters which are controlled at an OSF LOCA. The need for change may result from local knowledge of radar performance, or of other geographic, seasonal, and/or climatological effects. The timeliness of these changes may preclude the normal configuration change process procedures. In these cases, the site may submit an immediate parameter change request to the OSF using the following guidelines:

Requests may only be made by the Chairperson of the WSR-88D Unit Radar Committee with the concurrence of the URC voting members. These requests will be made in writing to the Director of the OSF. The OSF will send a copy of the change request to the AFWA/XPPM, HQ NWS W/OSO112, and FAA NEXRAD Focal Point.

The Adaptable Parameter Working Group (APWG) technically evaluates the immediate parameter change request within 2 working days of receipt and then responds to the OSF Director.

The OSF Director, who is the signatory authority for delegating to sites the responsibility to make immediate changes to OSF level parameters, responds in writing to the originator of the immediate parameter change request using standard agency procedures. In addition, the Director will deliver copies of the response to OSF Configuration Management (CM) and to the agency WSR-88D focal points.

The requesting site can implement the change upon receipt of an affirmative response from the OSF Director.

1.5.2 Routine Changes to OSF Controlled Adaptation Data

The triagencies may request changes to OSF-controlled adaptable parameter values. General guidance for DOC (NWS) and DOD Requests for Change (RC) is provided below.

NWS-originated parameter RC will first require the requesting office to submit its request to their regional headquarters WSR-88D focal point. If approved, the regional headquarters will forward the RC to the NWS NEXRAD Committee (NNC) for review. The NNC will forward approved requests to the OSF by memo to the OSF Director, for the attention of the OSF CM Section.

DOD-originated parameter requests for change should be submitted on AF FM 3215, C4 Systems Requirement Document. The form is submitted for base approval, MAJCOM approval, then AWS approval. If approved at all levels, AFWA/XPPM will submit the CSRD as a RC to the OSF Director, for the attention of the OSF CM section.

Requests for Change received by the OSF Director are forwarded to the OSF CM Section for processing into the Configuration Change Request (CCR) format. The CCR is forwarded to the APWG for their review and recommendation. If approved by the APWG, a recommendation is then forwarded to members of the OSF Configuration Control Board and to the OSF Director, who will approve or disapprove the recommended change. If the Director approves the change, the OSF CM Section will implement the change.

Chapter 2
Levels of Change Authority

2.1 Introduction

Chapter 2 defines the responsibilities of each level of change authority. Additionally, each Radar Product Generator (RPG) adaptable parameter designated with a Level of Change Authority (LOCA) of Unit Radar Committee (URC) or Agency is provided. ***By design, those adaptable parameters not specifically defined as URC or Agency LOCA in this document fall under the jurisdiction of the OSF LOCA.*** The listings also cross-reference the location (chapter and section) where the parameter can be found in subsequent chapters.

2.2 Levels of Change Authority Definitions

2.2.1 Operational Support Facility

The Operational Support Facility (OSF) through the Adaptable Parameter Working Group (APWG) is authorized to determine the general validity and range of adaptable parameter values for changes that involve technical and scientific characteristics of WSR-88D data acquisition and algorithmic processing. In addition, the OSF shall be authorized to determine, specifically, the values of the aforementioned default adaptable parameter values for WSR-88D equipment owned by Department of Defense, Department of Transportation, and Department of Commerce. Since the APWG shall remain subordinate to the NEXRAD Program Management Committee (PMC), the OSF level of change authority shall reflect the PMC's position on triagency policy in WSR-88D operations.

2.2.2 Unit Radar Committee

The Unit Radar Committee (URC) is authorized to change the values of WSR-88D adaptable parameters, and establish adaptation parameter policy for the principal users within the URC, insofar as these changes affect only the operation of the URC's WSR-88D system. Changes that a single URC are authorized to implement are identified in Table 2.3 - 1 and Table 2.4 - 1 and may include the “fine tuning” needed to meet local operational requirements, seasonal changes, and local climatological characteristics.

2.2.3 Agency

The Department of Defense (DOD), Department of Transportation (DOT), and Department of Commerce (DOC), each is authorized to change the values of adaptable parameters and establish WSR-88D adaptation parameter policy in order to meet their agency-specific mission requirements and criteria. Changes that a single agency are authorized to implement are identified in Table 2.5 - 1 and may involve user passwords and certain telecommunications settings.

2.3 URC LOCA Adaptable Parameters

Table 2.3 - 1 provides a listing of the RPG adaptable parameters under the change authority of the URC. Section numbers are provided identifying where additional information about the parameter can be found in subsequent chapters of this document.

Table 2.3 - 1: URC LOCA Adaptable Parameters

Parameter	Section
Alert Processing (Alert Thresholds and Product Alert Pairing)	3.2
Base Velocity Product Data Levels	4.11
Bi-Scan Minimum Range	6.6
Cell-Based VIL (Maximum)	6.3
Clutter Suppression Region Definitions	3.4
Combined Shear Contour Interval	6.4
Combined Shear Domain Resolution	6.4
Combined Shear Filter Number of Points	6.4
Combined Shear Elevation to Process	6.4
Composite Reflectivity Contour Interval	4.3
Contour Filter Level	4.3
Current Volume Coverage Pattern (VCP) Definition	3.10
Default Storm Direction	6.2
Default Storm Speed	6.2
Echo Top Contour Base	4.3
Hail Height (0° Celsius)	6.2
Hail Height (minus 20° Celsius)	6.2
Layer Composite Reflectivty - Lowest Height	4.5
Maximum Number of Cells in STI Alphanumeric Product	4.4
Maximum Number of Cells in SS Alphanumeric Product	4.4
Maximum Number of Cells in Hail Alphanumeric Product	4.4
Maximum Number of Cells in STI Attributes Table	4.4
Maximum Number of Cells in Combined Attributes Table	4.4
Maximum Number of Cells in Hail Attribute Table	4.4
Nominal Clutter Area (Precipitation Detection)	6.9
One and Three Hour Precipitation Product Data Levels	4.6
Precipitation Bias Adjustment Flag	4.2

Table 2.3 - 1: URC LOCA Adaptable Parameters

Parameter	Section
Storm Total Precipitation Product Data Levels	4.9
Velocity Azimuth Display (VAD) Beginning Azimuth	6.15
Velocity Azimuth Display (VAD) Ending Azimuth	6.15
Velocity Azimuth Display (VAD) Range	6.15

2.4 OSF-Level Adaptable Parameters Delegated to URC LOCA

To enable the field to "fine-tune" certain algorithm parameters, the OSF has delegated the change authority of selected parameters to the URC LOCA. The adaptable parameters in this category may **only** be modified in accordance to the guidance provided in this document. The limits of the URC authority and the range of allowable parameter selections are clearly defined in the **Delegated Authority Restrictions** subsection for each parameter. Table 2.4 - 1 provides a listing of the specific parameters delegated to the URC LOCA.

Table 2.4 - 1: OSF-Level Change Authority Delegated to URC-Level

Parameter	Section
Mesocyclone Minimum Number of Pattern Vectors (TPV)	6.8
POSH Offset	6.5
Tornado Detection Algorithm (TDA) Minimum Reflectivity Threshold	6.14
Tornado Detection Algorithm (TDA) Maximum Pattern Vector Range	6.14
Tornado Detection Algorithm (TDA) Minimized Adaptable Parameter Set	6.14
VAD and RCM Height Selections	4.10
Z-R Relationship	6.17

2.5 Agency LOCA Adaptable Parameters

Table 2.5 - 1 provides a listing of the RPG adaptable parameters under the change authority of the Agency. Section numbers are provided identifying where additional information about the parameter can be found in subsequent chapters of this document.

Table 2.5 - 1: Agency LOCA Adaptable Parameters

Parameter	Section
Environmental Wind Estimates	6.2
First Level Password	3.8
Dial-In User Disconnect Override Privileges	5.5
Dial-In User ID	5.3
Dial-In User Configuration Table	5.3
Dial-In User Maximum Connect Time Limit	5.3
Dial-In User Port Password	5.4
Rain Gage Data Acquisition (RGDAC) Phone Number 1	5.6
Rain Gage Data Acquisition (RGDAC) Phone Number 2	5.6
Status Update Frequency	3.9

NOTE

All adaptable parameters, unless explicitly defined as URC or Agency LOCA in Chapter 2 of this document, or changes or updates to this document, are under the OSF LOCA.

Chapter 3

Performance Optimization Parameters

3.1 Introduction

This chapter addresses the adaptable parameters that impact local WSR-88D data collection, quality and availability and associated user support. Many of the parameters contained in this chapter are designated as Unit Radar Committee (URC) or Agency Level of Change Authority (LOCA) and should be routinely modified to address changing meteorological conditions and operational requirements.

3.2 Alert Processing - URC LOCA

The WSR-88D alerting function will search data fields and algorithm output data to identify any phenomena selected as an alert criteria within the area designated by any associated Principal User Processor (PUP). (The sole exception being the MAX 1HR PRECIP alert which is not restricted to the alert area definitions.) Upon detection of alert criteria being met, the alerting function notifies the affected PUP(s) and, if specified, will generate and automatically distribute an alert-paired product to the appropriate PUP(s).

3.2.1 Alert Thresholds - URC LOCA

Up to 6 Alert Threshold Codes can be defined for each alert category. Individual threshold values should be selected to meet the local requirements of all associated users. All alert processing functions search the data fields out to 124 nm for each alert category except for the following 9 alert categories;

Grid Reflectivity (GR**)** - the composite reflectivity data field is processed out to 186 nm,

Grid Velocity (GV) - the base velocity data field is only searched to 62 nm,

Volume VAD (VD) - only the lowest VWP height is used to trigger this alert,

Volume TVS (VS) - a TVS must be identified within 62 nm to trigger this alert,

Volume Max Storm Reflectivity (VR) - the storm cell must be within 248 nm,

Volume Storm Top (VT) - the storm cell must be within 248 nm,

Forecast TVS (FS) - the forecasted position of the storm cell containing the TVS must fall within 62 nm,

Forecast Max Storm Reflectivity (FR) - the forecasted position of the storm cell must be within 248 nm, and

Forecast Storm Top (FT) - the forecasted position of the storm cell must be within 248 nm.

```
                          ALERT THRESHOLD EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,AL,
FEEDBACK:                                                        OPER A/

  (M)odify, {CODE}   (E)nd   (C)ancel               CATEGORY CODES
  (A)lert Threshold Values             ----------------------------------------
                                       GRID GROUP           13. Prob SVR Hail
                                       1.  Velocity         14. Storm Top
CODE CAT   T1   T2   T3   T4   T5   T6 2.  Comp Refl        15. Max 1hr Accum
-------------------------------------- 3.  Echo Tops        16-24. Not Used
                                       4.  SWP
-------------------------------------- 5.  Not Used         FORECAST GROUP
UNITS :                                6.  VIL              25. Max Hail Size
--------------------------------------                      26. Mesocyclone
MIN:                                   VOLUME GROUP         27. TVS
MAX:                                   7.  VAD              28. Max Storm Refl
                                       8.  Max Hail Size    29. Prob Hail
                                       9.  Mesocyclone      30. Prob SVR Hail
                                       10. TVS              31. Storm Top
                                       11. Max Storm Refl   32-41. Not Used
                                       12. Prob Hail
```

Figure 3.2-1

3.2.2 Product Alert Pairing - URC LOCA

When an alert is identified for any associated PUP, and that PUP has designated to receive the alert-paired product, the alert processing function will initiate a one-time request for the product specified on this menu.

```
                             PRODUCT ALERT PAIRING              PAGE  1 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                        OPER A/

(M)odify, {LINE#}                (E)nd            (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------


---------------------------------------
 1   GRID   GV      SWV       16    .13
 2   GRID   GR      CR        16    2.2
 3   GRID   GT      ET        16    2.2
 4   GRID   GP      SWP        4    2.2
 5   GRID   N/A
 6   GRID   GL      VIL       16    2.2
 7   VOL    VD      VAD        8
 8   VOL    VZ      HI
```

Figure 3.2-2

```
                             PRODUCT ALERT PAIRING                PAGE  2 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                          OPER A/

(M)odify, {LINE#}                (E)nd            (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------

---------------------------------------
 9   VOL    VM      SRR      16    .27
10   VOL    VS      TVS
11   VOL    VR      WER       8    .54
12   VOL    VH      RCS      16
13   VOL    VA      WER       8    .54
14   VOL    VT      ET       16    2.2
15   VOL    VP      OHP      16    1.1
16   VOL    N/A
```

Figure 3.2-3

```
                             PRODUCT ALERT PAIRING                PAGE  3 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                          OPER A/

(M)odify, {LINE#}                (E)nd            (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------

---------------------------------------
17   VOL    N/A
18   VOL    N/A
19   VOL    N/A
20   VOL    N/A
21   VOL    N/A
22   VOL    N/A
23   VOL    N/A
24   VOL    N/A
```

Figure 3.2-4

```
                             PRODUCT ALERT PAIRING                PAGE  4 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                          OPER A/

(M)odify, {LINE#}               (E)nd             (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------

---------------------------------------
25   FCST   FZ      HI
26   FCST   FM      SRR      16    .27
27   FCST   FS      TVS
28   FCST   FR      WER       8    .54
29   FCST   FH      RCS      16
30   FCST   FA      WER       8    .54
31   FCST   FT      ET       16    2.2
32   FCST   N/A
```

Figure 3.2-5

```
                             PRODUCT ALERT PAIRING                PAGE  5 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                          OPER A/

(M)odify, {LINE#}               (E)nd             (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------

---------------------------------------
33   FCST   N/A
34   FCST   N/A
35   FCST   N/A
36   FCST   N/A
37   FCST   N/A
38   FCST   N/A
39   FCST   N/A
40   FCST   N/A
```

Figure 3.2-6

```
                             PRODUCT ALERT PAIRING                PAGE  6 OF  6
COMMAND: AD,*****,P,
FEEDBACK:                                                          OPER A/

(M)odify, {LINE#}                (E)nd            (C)ancel
(P)age, {N PAGES}

                            Data
N   Group   Cat    Prod     Level  Res
---------------------------------------

---------------------------------------
41   FCST   N/A
```

Figure 3.2-7

3.3 Background Map Associations

This menu specifies which maps are transmitted to nonassociated PUPs when a dial-in request is honored and the PUP has requested that maps accompany the product.

.

```
                        BACKGROUND MAP ASSOC EDIT SCREEN          PAGE  1 OF  1
COMMAND: AD,*****,B,19,
FEEDBACK:                                                          OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  19   Prod Name: R
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-1

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,20,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  20   Prod Name: R
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-2

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,25,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  25   Prod Name: V
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-3

```
                        BACKGROUND MAP ASSOC EDIT SCREEN          PAGE  1 OF  1
COMMAND: AD,*****,B,27,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  27   Prod Name: V
                              MAP NUMBER
                  1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport       13. Rstrctd Area
 2. County       8. Airway(High)  14. Prohbtd Area
 3. Highway      9. Airway(Low)   15. Radar Sites
 4. River       10. NAVAID        16. City Names
 5. River Basin 11. Warning Area  17. County Names
 6. LFM Grid    12. Mil Ops Area  18. 18-32 na
```

Figure 3.3-4

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,28,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  28   Prod Name: SW
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-5

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,30,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  30   Prod Name: SW
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                  X X         X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-6

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,31,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  31   Prod Name: USP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X   X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-7

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,34,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  34   Prod Name: CFC
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
        X X X   X                 X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-8

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,38,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an “X” under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  38   Prod Name: CR
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X                           X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-9

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,41,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an “X” under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  41   Prod Name: ET
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X                   X   X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-10

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,47,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  47   Prod Name: SWP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
      X                             X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-11

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,48,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  48   Prod Name: VWP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
      X                             X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-12

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,56,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  56   Prod Name: SRM
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
              X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-13

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,57,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  57   Prod Name: VIL
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X X       X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-14

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,58,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  58   Prod Name: STI
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                            X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-15

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,59,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  59   Prod Name: HI
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                            X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-16

```
                         BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,60,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                            Prod Id:  60   Prod Name: M
                               MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                                  X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-17

```
                         BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,61,
FEEDBACK:                                                            OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                            Prod Id:  61   Prod Name: TVS
                               MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                          X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-18

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,62,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  62   Prod Name: SS
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                            X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-19

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,65,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  65   Prod Name: LRM
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                X     X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-20

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,66,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  66   Prod Name: LRM
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                X     X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-21

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,78,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                          Prod Id:  78   Prod Name: OHP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X   X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-22

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,79,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an “X” under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  79   Prod Name: THP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X   X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-23

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,80,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an “X” under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  80   Prod Name: STP
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
    X X   X X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-24

```
                        BACKGROUND MAP ASSOC EDIT SCREEN           PAGE  1 OF  1
COMMAND: AD,*****,B,90,
FEEDBACK:                                                           OPER A/

Select one: (M)odify  (E)nd  (C)ancel
Place an "X" under the background maps to be paired with this product.
No more than  6 maps per product.
                                           Prod Id:  90   Prod Name: LRM
                              MAP NUMBER
                      1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3
    1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
    ---------------------------------------------------------------
                X     X
    ---------------------------------------------------------------

 1. State        7. Airport        13. Rstrctd Area
 2. County       8. Airway(High)   14. Prohbtd Area
 3. Highway      9. Airway(Low)    15. Radar Sites
 4. River       10. NAVAID         16. City Names
 5. River Basin 11. Warning Area   17. County Names
 6. LFM Grid    12. Mil Ops Area   18. 18-32 na
```

Figure 3.3-25

3.4 Clutter Suppression Control - URC LOCA

Clutter suppression is used to remove the power returned by clutter targets from a range bin ***prior*** to the calculation of the base data.

Ground clutter and anomalous propagation (AP) contamination has a significant effect on the accuracy of the base data. The clutter induced bias in the base data not only brings into question the reliability of the data presented on the base products but also has a detrimental effect on ***all*** downstream algorithms.

Clutter suppression filters are designed to reduce the power of those signals whose mean radial velocity is at or near zero. To do this, clutter suppression filters reduce signal power within a "notch width" centered about the zero mean radial velocity value. This reduction in signal power effectively decreases the clutter's power contribution in the given range bin. To maintain meteorological return integrity, only the signal power whose radial motion falls within the notch width is reduced. Therefore, with appropriate clutter suppression invoked, the bias in the base data (R, V and SW) estimates due to clutter contamination within the range bin can be minimized.

The clutter suppression regions defined on lines (Regions) 1 and 2 in the following example screens ensure the normal ground clutter pattern, as defined by the Bypass Map, is addressed. These two line should always be included in each clutter suppression region file definition. Additional regions (operator select code 2 forcing clutter suppression) should be defined on line three and subsequent lines as needed to address transient clutter (e. g., AP).

3.4.1 Clutter Suppression Region File 11

```
                          CLUTTER SUPPRESSION REGIONS              PAGE  1 OF  2
COMMAND: AD,*****,CL,C, 11,
FEEDBACK:                                                           OPER A/

(M)odify, {LINE#}               (DE)lete, {LINE#}          (DO)wnload
(E)nd                           (C)ancel

         Start  Stop   Start   Stop    Elev Seg  Operator     Channel Width
Region   Range  Range Azimuth Azimuth   Number   Sel Code     D          S
---------------------------------------------------------------------------


---------------------------------------------------------------------------
   1        2    510      0     360       1         1         2          2
   2        2    510      0     360       2         1         2          2
   3        0      0      0       0       0         0         0          0
   4        0      0      0       0       0         0         0          0
   5        0      0      0       0       0         0         0          0
   6        0      0      0       0       0         0         0          0
   7        0      0      0       0       0         0         0          0
   8        0      0      0       0       0         0         0          0
```

Figure 3.4-1

3.4.2 Clutter Suppression Region File 21

```
                         CLUTTER SUPPRESSION REGIONS              PAGE  1 OF  2
COMMAND: AD,*****,CL,C, 21,
FEEDBACK:                                                           OPER A/

(M)odify, {LINE#}               (DE)lete, {LINE#}          (DO)wnload
(E)nd                           (C)ancel

         Start  Stop   Start   Stop    Elev Seg  Operator     Channel Width
Region   Range  Range Azimuth Azimuth   Number   Sel Code     D          S
---------------------------------------------------------------------------


---------------------------------------------------------------------------
   1        2    510      0     360       1         1         2          2
   2        2    510      0     360       2         1         2          2
   3        0      0      0       0       0         0         0          0
   4        0      0      0       0       0         0         0          0
   5        0      0      0       0       0         0         0          0
   6        0      0      0       0       0         0         0          0
   7        0      0      0       0       0         0         0          0
   8        0      0      0       0       0         0         0          0
```

Figure 3.4-2

3.4.3 Clutter Suppression Region File 31

```
                         CLUTTER SUPPRESSION REGIONS              PAGE  1 OF  2
COMMAND: AD,*****,CL,C, 31,
FEEDBACK:                                                           OPER A/

(M)odify, {LINE#}                (DE)lete, {LINE#}           (DO)wnload
(E)nd                            (C)ancel

         Start  Stop   Start   Stop    Elev Seg  Operator     Channel Width
Region   Range  Range Azimuth Azimuth   Number   Sel Code     D          S
---------------------------------------------------------------------------


---------------------------------------------------------------------------
   1        2    510      0     360       1         1         2          2
   2        2    510      0     360       2         1         2          2
   3        0      0      0       0       0         0         0          0
   4        0      0      0       0       0         0         0          0
   5        0      0      0       0       0         0         0          0
   6        0      0      0       0       0         0         0          0
   7        0      0      0       0       0         0         0          0
   8        0      0      0       0       0         0         0          0
```

Figure 3.4-3

3.4.4 Clutter Suppression Region File 32

```
                         CLUTTER SUPPRESSION REGIONS              PAGE  1 OF  2
COMMAND: AD,*****,CL,C, 32,
FEEDBACK:                                                           OPER A/

(M)odify, {LINE#}                (DE)lete, {LINE#}           (DO)wnload
(E)nd                            (C)ancel

         Start  Stop   Start   Stop    Elev Seg  Operator     Channel Width
Region   Range  Range Azimuth Azimuth   Number   Sel Code     D          S
---------------------------------------------------------------------------


---------------------------------------------------------------------------
   1        2    510      0     360       1         1         2          2
   2        2    510      0     360       2         1         2          2
   3        0      0      0       0       0         0         0          0
   4        0      0      0       0       0         0         0          0
   5        0      0      0       0       0         0         0          0
   6        0      0      0       0       0         0         0          0
   7        0      0      0       0       0         0         0          0
   8        0      0      0       0       0         0         0          0
```

Figure 3.4-4

3.4.5 Supplemental Information - Operator-Defined Clutter Suppression Regions

The UCP operator may specify up to 15 individual regions per each of the four Clutter Suppression Region Files (11, 21, 31, 32). (**Note:** Clutter Suppression Region Files are not associated with any ***specific*** VCP.) Each region is delineated by start and stop ranges, start and stop azimuths, and an elevation segment number. The elevation segment number specifies which set of predefined elevation slices to include within the region definition. The elevations included in the different segments are defined in the RDA adaptation data.

The Clutter Suppression Regions are used to control the application of clutter suppression within the defined area by selecting from the options listed below.

Options for Clutter Suppression Within Operator-Defined Regions. Within each operator-defined region, the UCP operator has three choices to determine how filtering will be invoked.

a. No Clutter Suppression: Operator Select Code 0. This selection will turn off ***ALL*** filtering, including the Bypass Map identified areas, within the confines of the operator-defined region.

b. Bypass Map in Control Using the Operator-Specified Notch Width: Operator Select Code 1. This selection will invoke the selected suppression level (notch width) for each area identified by the Bypass Map within the confines of the operator-defined region.

c. Forced Clutter Suppression Using the Operator-Specified Notch Width: Operator Select Code 2. This option forces the specified suppression level (notch width) for ***every*** range bin within the confines of the operator-defined region.

Notch Width Selections. There are three notch width selections, or levels of suppression, available for inclusion in the Default Notch Width Map definitions and Clutter Suppression Region definitions (with Operator Select Codes 1 or 2). The notch width determines the target motions, around zero radial velocity, that will be subjected to signal power reduction (suppression). The Surveillance channel and Doppler channel are suppressed using different notch width values (see Table 3.4 - 1) to reduce base data estimate bias in the different channels.

a. Notch Width Selection 1. Invokes a suppression level of approximately 30 dB (Low). See Table 3.4 - 1 for typical notch width values.

b. Notch Width Selection 2. Invokes a suppression level of approximately 40 dB (Medium). See Table 3.4 - 1 for typical notch width values.

c. Notch Width Selection 3. Invokes a suppression level of approximately 50 dB (High). See Table 3.4 - 1 for typical notch width values.

Table 3.4 - 1: Notch Width Selections and Suppression Values

Notch Width Selection	1		2		3	
Channel	**kts**	**dB**	**kts**	**dB**	**kts**	**dB**
Surveillance	3.38 (±1.69)	≈30	4.85 (±2.43)	≈40	6.79 (±3.40)	≈50
Doppler	4.58 (±2.29)	≈30	6.05 (±3.03)	≈40	8.92 (±4.46)	≈50

NOTE

By design, the notch widths vary based upon antenna rotation rate. Therefore, the value listed in Table 3.4 - 1 is an approximation and varies with elevation angle and antenna rotation rate.

With regard to forced clutter suppression, the SMALLEST AREA and LOWEST LEVEL of suppression that will properly remove the ground clutter or anomalous propagation contamination of the base data should always be used. Indiscriminate use of the highest suppression level (Notch Width 3) over all azimuths, ranges, and elevation angles has strong detrimental effects on the integrity of all reflectivity and reflectivity-based products such as precipitation and VIL in those regions of real meteorological echo that are located along the zero radial velocity isodop.

3.4.6 Additional Reference Material

For additional information concerning the application of clutter filtering, refer to the following papers:

WSR-88D Clutter Suppression and Its Impact On Meteorological Data Interpretation, Chrisman, et al, Jan 1995, and

An Introduction to the WSR-88D Clutter Suppression, and Some Tips for Effective Suppression Utilization, Goss and Chrisman, 1995.

3.4.7 Bypass Map Editor

This menu allows the UCP operator to edit the RDASOT-generated Bypass Map.

```
                          CLUTTER BYPASS FILTER EDITOR             PAGE  1 OF  1
COMMAND: AD,*****,CL,B,
FEEDBACK:                                                           OPER A/

(EX)amine, {SEG#, RAD#, KM}     (M)odify, {(H)EX / (B)INARY}
(CA)ncel     (R)equest      (D)ownload      (CR)eate     (EN)d

RANGE    -+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
            0     4     9     1     1     2     2     3     3     4     4     5
                  8     6     4     9     4     8     3     8     3     8     1
SEGMENT#:                     4     2     0     8     6     4     2     0     2
RADIAL#:
       +--------------------------+------+--------------------------+
       |                          |      |                          |
       +--------------------------+------+--------------------------+
KM

                      +------+------+------+------+  (Note: 0 means perform
             HEX:     |      |      |      |      |   clutter filtering; 1 means
             BINARY:  |      |      |      |      |   bypass the clutter filter;
                      +------+------+------+------+   HEX “F” = BINARY “1111”)
```

Figure 3.4-5

3.5 Adaptation Generation and Distribution Control Lists

The Generation and Distribution Control list (GDCL) ensures product generation and product availability to support the requirements of the National Archives (Archive Level III), Nonassociated PUPs (NAPUPs), PUES (AFOS), and Other Users (NIDS). The GDCL ***DOES NOT*** impact the availability of products for Associated PUPs (APUPs), including the Collocated PUP (RPGOP). Products generated and distributed to the APUPs are determined by their individual Routine Product Set (RPS) lists, operator-initiated one-time requests, and operator-specified alert-paired products.

3.5.1 Mode A (Precipitation) List

This Generation and Distribution Control list must specify, at a minimum, the product generation, archive and availability requirements defined in FMH-11, Part A, Table 7-1. Additional products may be added for generation and NAPUP distribution, however, these additional products must not be archived or distributed to the Other Users (see section 3.5.3). This GDCL list will be automatically invoked upon RPG restart or weather mode change from Clear-Air Mode (Mode B) to the Precipitation Mode (Mode A).

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  1 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                            OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


-----------------------------------------------------------------------------
 1  R      8 .54   0.0     0.0      0.0     0   0   0    0
 2  R      8 1.1   0.0     0.0      0.0     0   0   0    0
 3  R      8 2.2   0.0     0.0      0.0     0   0   0    0
 4  R     16 .54  -4.0     0.0      0.0     1  -1   1  180   Y            -4
 5  R     16 1.1  -1.0     0.0      0.0     1  -1   1  180   Y            -1
 6  R     16 2.2   0.0     0.0      0.0     0   0   0    0
 7  V      8 .13   0.0     0.0      0.0     0   0   0    0
 8  V      8 .27   0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-1

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  2 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                            OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


-----------------------------------------------------------------------------
 9  V      8 .54   0.0     0.0      0.0     0   0   0    0
10  V     16 .13  -1.0     0.0      0.0     1  -1   1  180   Y
11  V     16 .27   0.0     0.0      0.0     0   0   0    0
12  V     16 .54  -4.0     0.0      0.0     1  -1   1  180   Y            -4
13  SW     8 .13  -1.0     0.0      0.0     1  -1   1  180   Y
14  SW     8 .27   0.0     0.0      0.0     0   0   0    0
15  SW     8 .54  -4.0     0.0      0.0     1  -1   1  180   Y
16  USP   16 1.1   0.0    12.0     24.0     3   0   3  180   Y
```

Figure 3.5-2

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  3 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                            OPER A/L  21
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd                     (R)eplace, {WX MODE}

         DTA                                  AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ------------------------------------------------------------------------------


------------------------------------------------------------------------------
17  DHR  256 .54    0.0     0.0      0.0     0   0   0    0
18  HSR   16 .54    0.0     0.0      0.0     1   0   1  180   Y
19  CFC    8 .54    0.0     0.0      0.0     1   1   1  360   Y
20  CR     8 .54    0.0     0.0      0.0     0   0   0    0
21  CR     8 2.2    0.0     0.0      0.0     0   0   0    0
22  CR    16 .54    0.0     0.0      0.0     0   0   0    0
23  CR    16 2.2    0.0     0.0      0.0     1   3   1  180   Y            1
24  CRC      .54    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-3

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  4 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------


------------------------------------------------------------------------------
25  CRC       2.2    0.0     0.0      0.0     0   0   0    0
26  ET     16 2.2    0.0     0.0      0.0     1   3   1  180   Y            1
27  ETC       2.2    0.0     5.0      0.0     0   0   0    0
28  SWR    16 .54    0.0     0.0      0.0     0   0   0    0
29  SWV    16 .13    0.0     0.0      0.0     0   0   0    0
30  SWW    16 .13    0.0     0.0      0.0     0   0   0    0
31  SWS    16 .27    0.0     0.0      0.0     0   0   0    0
32  SWP     4 2.2    0.0     0.0      0.0     1   1   1  180   Y
```

Figure 3.5-4

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  5 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------


------------------------------------------------------------------------------
33  VWP              0.0     0.0      0.0     1   6   1  180   Y            1
34  CM               0.0     0.0      0.0     0   0   0    0
35  RCS    16        0.0     0.0      0.0     0   0   0    0
36  VCS    16        0.0     0.0      0.0     0   0   0    0
37  SCS     8        0.0     0.0      0.0     0   0   0    0
38  WER     8 .54    0.0     0.0      0.0     0   0   0    0
39                   0.0     0.0      0.0     0   0   0    0
40  SRR    16 .27    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-5

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  6 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                 AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
41  SRM   16 .54   -2.0     0.0      0.0     1  -1   1  180   Y           -2
42  VIL   16 2.2    0.0     0.0      0.0     1   1   1  180   Y            1
43  STI             0.0     0.0      0.0     1   1   1  180   Y
44  HI              0.0     0.0      0.0     1   1   1  180   Y
45  M               0.0     0.0      0.0     1   1   1  180   Y
46  TVS             0.0     0.0      0.0     1   1   1  180   Y
47  SS              0.0     0.0      0.0     1   3   1  180   Y
48  LRA    8 2.2    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-6

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  7 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/L  21
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd                     (R)eplace, {WX MODE}

         DTA                                 AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
49  LRA    8 2.2    0.0     0.0      0.0     0   0   0    0
50  LRM    8 2.2    0.0     0.0      0.0     1   0   1  180   Y             1
51  LRM    8 2.2    0.0     0.0      0.0     1   0   1  180   Y             1
52  APR    8 2.2    0.0     0.0      0.0     1   0   1  180   Y             1
53                  0.0     0.0      0.0     0   0   0    0
54                  0.0     0.0      0.0     0   0   0    0
55                  0.0     0.0      0.0     0   0   0    0
56                  0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-7

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  8 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
57                  0.0     0.0      0.0     0   0   0    0
58  UAM             0.0     0.0      0.0     0   0   0    0
59  RCM             0.0     0.0      0.0     1   1   1  180   Y    1
60  FTM             0.0     0.0      0.0     0   0   0    0
61                  0.0     0.0      0.0     0   0   0    0
62                  0.0     0.0      0.0     0   0   0    0
63  OHP   16 1.1    0.0     0.0      0.0     1   3   1  180   Y            1
64  THP   16 1.1    0.0     0.0      0.0     3   0   3  180   Y            3
```

Figure 3.5-8

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  9 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
65  STP   16 1.1    0.0     0.0      0.0     1   3   1  180   Y            1
66  DPA  256        0.0     0.0      0.0     1   1   1  180   Y    1   1   1
67  SPD             0.0     0.0      0.0     1   1   1  180   Y        1
68  IRM             0.0     0.0      0.0     1   1   1  180
69  VAD    8        1.0     0.0      0.0     0   0   0    0
70  RCS    8        0.0     0.0      0.0     0   0   0    0
71  VCS    8        0.0     0.0      0.0     0   0   0    0
72  CS    16        0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-9

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE 10 OF 10
COMMAND: AD,*****,G,A,
FEEDBACK:                                                          OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                 AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------

-----------------------------------------------------------------------------
73  CSC            0.0     0.0      0.0     0   0   0    0
74  LRA    8 2.2   0.0     0.0      0.0     0   0   0    0
75  LRM    8 2.2   0.0     0.0      0.0     1   0   1  180   Y            1
```

Figure 3.5-10

3.5.2 Mode B (Clear-Air) List

This Generation and Distribution Control list must specify, at a minimum, the product generation, archive and availability requirements defined in FMH-11, Part A, Table 7-2. Additional products may be added for generation and NAPUP distribution, however, these additional products must not be archived or distributed to the Other Users. This GDCL list will be automatically invoked upon RPG restart or weather mode change from Precipitation Mode (Mode A) to the Clear-Air Mode (Mode B)

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  1 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                            OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------


-----------------------------------------------------------------------------
 1  R      8 .54    0.0     0.0      0.0     0   0   0    0
 2  R      8 1.1    0.0     0.0      0.0     0   0   0    0
 3  R      8 2.2   -1.0     0.0      0.0     1   0   1  180   Y
 4  R     16 .54   -4.0     0.0      0.0     1  -1   1  180   Y            -4
 5  R     16 1.1   -1.0     0.0      0.0     1   0   1  180                -1
 6  R     16 2.2    1.0     0.0      0.0     0   0   0    0
 7  V      8 .13    0.0     0.0      0.0     0   0   0    0
 8  V      8 .27    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-11

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  2 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                            OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                     AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------


-----------------------------------------------------------------------------
 9  V      8 .54    0.0     0.0      0.0     0   0   0    0
10  V     16 .13   -1.0     0.0      0.0     1  -1   1  180   Y
11  V     16 .27   -3.0     0.0      0.0     1   0   1  180   Y
12  V     16 .54   -4.0     0.0      0.0     1  -1   1  180   Y            -4
13  SW     8 .13   -1.0     0.0      0.0     1  -1   1  180   Y
14  SW     8 .27   -3.0     0.0      0.0     1   0   1  180   Y
15  SW     8 .54   -4.0     0.0      0.0     1  -1   1  180   Y
16  USP   16 1.1    0.0    12.0     24.0     3   0   3  180   Y
```

Figure 3.5-12

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  3 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                  AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------

-----------------------------------------------------------------------------
17  DHR  256 .54    0.0     0.0      0.0     0   0   0    0
18  HSR   16 .54    0.0     0.0      0.0     1   0   1  180   Y
19  CFC    8 .54    0.0     0.0      0.0     1   1   1  360   Y
20  CR     8 .54    0.0     0.0      0.0     0   0   0    0
21  CR     8 2.2    0.0     0.0      0.0     1   3   1  180   Y            1
22  CR    16 .54    0.0     0.0      0.0     0   0   0    0
23  CR    16 2.2    0.0     0.0      0.0     1   3   1  180   Y            1
24  CRC      .54    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-13

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  4 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                  AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 ----------------------------------------------------------------------------

-----------------------------------------------------------------------------
25  CRC      2.2    0.0     0.0      0.0     0   0   0    0
26  ET    16 2.2    0.0     0.0      0.0     0   0   0    0
27  ETC      2.2    0.0     5.0      0.0     0   0   0    0
28  SWR   16 .54    0.0     0.0      0.0     0   0   0    0
29  SWV   16 .13    0.0     0.0      0.0     0   0   0    0
30  SWW   16 .13    0.0     0.0      0.0     0   0   0    0
31  SWS   16 .27    0.0     0.0      0.0     0   0   0    0
32  SWP    4 2.2    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-14

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  5 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                       AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
33  VWP            0.0     0.0      0.0     1   6   1  180   Y            1
34  CM             0.0     0.0      0.0     0   0   0    0
35  RCS   16       0.0     0.0      0.0     0   0   0    0
36  VCS   16       0.0     0.0      0.0     0   0   0    0
37  SCS    8       0.0     0.0      0.0     0   0   0    0
38  WER    8 .54   0.0     0.0      0.0     0   0   0    0
39                 0.0     0.0      0.0     0   0   0    0
40  SRR   16 .27   0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-15

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  6 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                       AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
41  SRM   16 .54   0.0     0.0      0.0     0   0   0    0
42  VIL   16 2.2   0.0     0.0      0.0     0   0   0    0
43  STI            0.0     0.0      0.0     0   0   0    0
44  HI             0.0     0.0      0.0     0   0   0    0
45  M              0.0     0.0      0.0     0   0   0    0
46  TVS            0.0     0.0      0.0     0   0   0    0
47  SS             0.0     0.0      0.0     0   0   0    0
48  LRA    8 2.2   0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-16

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  7 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                          OPER A/L  21
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd                     (R)eplace, {WX MODE}

         DTA                                   AUT AUT  STO  NA          OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
49  LRA    8 2.2    0.0     0.0      0.0     0   0   0    0
50  LRM    8 2.2    0.0     0.0      0.0     1   0   1  180   Y            1
51  LRM    8 2.2    0.0     0.0      0.0     0   0   0    0
52  APR    8 2.2    0.0     0.0      0.0     1   0   1  180   Y            1
53                  0.0     0.0      0.0     0   0   0    0
54                  0.0     0.0      0.0     0   0   0    0
55                  0.0     0.0      0.0     0   0   0    0
56                  0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-17

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  8 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                          OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                   AUT AUT  STO  NA          OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


------------------------------------------------------------------------------
57                  0.0     0.0      0.0     0   0   0    0
58  UAM             0.0     0.0      0.0     0   0   0    0
59  RCM             0.0     0.0      0.0     1   1   1  180   Y    1
60  FTM             0.0     0.0      0.0     0   0   0    0
61                  0.0     0.0      0.0     0   0   0    0
62                  0.0     0.0      0.0     0   0   0    0
63  OHP   16 1.1    0.0     0.0      0.0     1   0   1  180   Y           1
64  THP   16 1.1    0.0     0.0      0.0     3   0   3  180   Y           3
```

Figure 3.5-18

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE  9 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                 AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


-----------------------------------------------------------------------------
65  STP   16 1.1    0.0     0.0      0.0     1   0   1  180   Y           1
66  DPA  256        0.0     0.0      0.0     1   1   1  180   Y    1   1   1
67  SPD             0.0     0.0      0.0     1   1   1  180   Y        1
68  IRM             0.0     0.0      0.0     1   1   1  180
69  VAD    8        0.0     0.0      0.0     0   0   0    0
70  RCS    8        0.0     0.0      0.0     0   0   0    0
71  VCS    8        0.0     0.0      0.0     0   0   0    0
72  CS    16        0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-19

```
                ADAPTATION GENERATION AND DISTRIBUTION CONTROL     PAGE 10 OF 10
COMMAND: AD,*****,G,B,
FEEDBACK:                                                           OPER A/
Select menu item.

(M)odify, {LINE#}        (D)elete, {LINE#}         (C)ancel
(P)age, {N PAGES}        (E)nd

         DTA                                 AUT AUT  STO  NA           OTH
 N  PROD LVL RES  SLICE  PARAM 1  PARAM 2  GEN ARC STO  TIM  PUP PUES RFC USR
 -----------------------------------------------------------------------------


-----------------------------------------------------------------------------
73  CSC             0.0     0.0      0.0     0   0   0    0
74  LRA    8 2.2    0.0     0.0      0.0     0   0   0    0
75  LRM    8 2.2    0.0     0.0      0.0     0   0   0    0
```

Figure 3.5-20

3.5.3 Supplemental Information

The WSR-88D RPG supports three Generation and Distribution Control lists. Two of these lists (one for each weather mode) are stored in the RPG adaptation data and should reflect the requirements specified in FMH-11 Part A, Tables 7-1 and 7-2. These two adaptation lists are permanent and are automatically activated upon an RPG reboot or a weather mode change. The third GDCL is maintained in memory and is the currently active list. This “current” GDCL is used to determine the RPG's contribution to the master product generation and distribution list for the current volume scan. The “current” GDCL is temporary and will be replaced each time the RPG is rebooted or the weather mode changes.

The GDCL specifies the minimum set of products and which elevation angles of elevation-based products to generate each volume scan. Additionally, the GDCL specifies which product types will be automatically distributed to the Other User ports (NIDS). The GDCL controls the distribution of product types to the Other User ports, but not specific elevation angles. Therefore, if an elevation-based product is generated and that product type is enabled for Other User port distribution, every elevation angle generated will be automatically sent to the Other User port.

In the past, sites have modified their Adaptation GDCLs to always force generation (and therefore, NIDS distribution) of several additional elevation angles of elevation-based base products each volume scan above those specified in FMH-11. These additional products being automatically distributed to the NIDS vendors are causing narrowband loadshedding problems.

If it is desired to make additional elevation angles of NIDS-authorized products available for NAPUP requests, add those elevation angles to your RPS list. As long as the product type is enabled for NAPUP distribution on the GDCL, a NAPUP may request any available elevation angle of that product, regardless of the source forcing its generation.

3.6 Load Shedding Control

The RPG continuously monitors the utilization levels of its data input rate, data processing, storage, and distribution functions. When load control measures are warranted, the load shedding control menus ensure systematic control of load shedding. This systematic control ensures that the most important data is always available to support operations.

3.6.1 Load Shed Categories, Mode A

When any utilization level reaches its predetermined threshold, the RPG initiates automatic load control measures to ensure continued RPG operation. This Load Shed Category menu sets the threshold values for Weather Mode A.

```
                              LOAD SHED CATEGORIES                PAGE  1 OF  1
COMMAND: AD,*****,L,C,A,
FEEDBACK:                                                          OPER A/

(M)odify,{LINE#}     (E)nd      (C)ancel


 N     Category             Warn   Alarm
-----------------------------------------

-----------------------------------------
 1   CPU                      85      95
 2   MEMORY                  100     100
 3   DISTRIBUTION             95     100
 4   STORAGE                  85      98
 5   INPUT BUFFER             85      90
 6   ARCHIVE III              95     100
 7   WIDEBAND USER            50      75
```

Figure 3.6-1

3.6.2 Load Shed Categories, Mode B

When any utilization level reaches its predetermined threshold, the RPG initiates automatic load control measures to ensure continued RPG operation. This Load Shed Category menu sets the threshold values for Weather Mode B.

```
                              LOAD SHED CATEGORIES                  PAGE  1 OF  1
COMMAND: AD,*****,L,C,B,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}     (E)nd      (C)ancel


 N     Category             Warn   Alarm
------------------------------------------


------------------------------------------
 1   CPU                      85      95
 2   MEMORY                  100     100
 3   DISTRIBUTION             95     100
 4   STORAGE                  85      98
 5   INPUT BUFFER             85      90
 6   ARCHIVE III              95     100
 7   WIDEBAND USER            50      75
```

Figure 3.6-2

3.6.3 Load Shed Products, Mode A

When load shedding occurs, the goal is to ensure that products critical to the decision making process continue to be available at the expense of lower priority products. These Load Shed Products menus set the relative product priorities (the higher the number, the higher the priority) for Weather Mode A.

```
                               LOAD SHED PRODUCTS                   PAGE  1 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------


------------------------------------
 1  R          8     .54       56
 2  R          8     1.1       55
 3  R          8     2.2       54
 4  R         16     .54       89
 5  R         16     1.1       88
 6  R         16     2.2       87
 7  V          8     .13       53
 8  V          8     .27       52
```

Figure 3.6-3

```
                               LOAD SHED PRODUCTS                  PAGE  2 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------


------------------------------------
 9  V          8     .54       51
10  V         16     .13       86
11  V         16     .27       85
12  V         16     .54       84
13  SW         8     .13       60
14  SW         8     .27       59
15  SW         8     .54       58
16  USP       16     1.1       57
```

Figure 3.6-4

```
                               LOAD SHED PRODUCTS                  PAGE  3 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------


------------------------------------
17  DHR      256     .54       57
18  HSR       16     .54       57
19  CFC        8     .54       99
20  CR         8     .54       48
21  CR         8     2.2       47
22  CR        16     .54       76
23  CR        16     2.2       75
24  CRC              .54       44
```

Figure 3.6-5

```
                                LOAD SHED PRODUCTS                   PAGE  4 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                             OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
25  CRC              2.2       43
26  ET         16    2.2       66
27  ETC              2.2       45
28  SWR        16    .54       94
29  SWV        16    .13       93
30  SWW        16    .13       92
31  SWS        16    .27       46
32  SWP         4    2.2       69
```

Figure 3.6-6

```
                                LOAD SHED PRODUCTS                   PAGE  5 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                             OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
33  VWP                        82
34  CM                         96
35  RCS        16              98
36  VCS        16              97
37  SCS         8              95
38  WER         8    .54       99
39                              0
40  SRR        16    .27       67
```

Figure 3.6-7

```
                                LOAD SHED PRODUCTS                  PAGE  6 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
41  SRM       16     .54       68
42  VIL       16     2.2       83
43  STI                        74
44  HI                         72
45  M                          71
46  TVS                        70
47  SS                         73
48  LRA        8     2.2       42
```

Figure 3.6-8

```
                                LOAD SHED PRODUCTS                  PAGE  7 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
49  LRA        8     2.2       41
50  LRM        8     2.2       63
51  LRM        8     2.2       62
52  APR        8     2.2       62
53                              0
54                              0
55                              0
56                              0
```

Figure 3.6-9

```
                                LOAD SHED PRODUCTS                 PAGE  8 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
57                             0
58  UAM                       91
59  RCM                       65
60  FTM                       90
61                             0
62                             0
63  OHP       16     1.1      81
64  THP       16     1.1      77
```

Figure 3.6-10

```
                                LOAD SHED PRODUCTS                 PAGE  9 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
65  STP       16     1.1      78
66  DPA      256              80
67  SPD                       79
68  IRM                       64
69  VAD        8              57
70  RCS        8              50
71  VCS        8              49
72  CS        16              39
```

Figure 3.6-11

```
                               LOAD SHED PRODUCTS                  PAGE 10 OF 10
COMMAND: AD,*****,L,P,A,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
73  CSC                       38
74  LRA         8     2.2     40
75  LRM         8     2.2     61
```

Figure 3.6-12

3.6.4 Load Shed Products, Mode B

When load shedding occurs, the goal is to ensure that products critical to the decision making process continue to be available at the expense of lower priority products. These Load Shed Products menus set the relative product priorities (the higher the number, the higher the priority) for Weather Mode B.

```
                               LOAD SHED PRODUCTS                  PAGE  1 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
 1  R           8     .54     56
 2  R           8     1.1     55
 3  R           8     2.2     54
 4  R          16     .54     89
 5  R          16     1.1     88
 6  R          16     2.2     87
 7  V           8     .13     53
 8  V           8     .27     52
```

Figure 3.6-13

```
                                LOAD SHED PRODUCTS                    PAGE  2 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                              OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
 9  V          8     .54       51
10  V         16     .13       86
11  V         16     .27       85
12  V         16     .54       84
13  SW         8     .13       60
14  SW         8     .27       59
15  SW         8     .54       58
16  USP       16     1.1       57
```

Figure 3.6-14

```
                                LOAD SHED PRODUCTS                    PAGE  3 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                              OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
17  DHR      256     .54       57
18  HSR       16     .54       57
19  CFC        8     .54       99
20  CR         8     .54       48
21  CR         8     2.2       47
22  CR        16     .54       76
23  CR        16     2.2       75
24  CRC              .54       44
```

Figure 3.6-15

```
                               LOAD SHED PRODUCTS                  PAGE  4 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
25  CRC              2.2       43
26  ET        16     2.2       66
27  ETC              2.2       45
28  SWR       16     .54       94
29  SWV       16     .13       93
30  SWW       16     .13       92
31  SWS       16     .27       46
32  SWP        4     2.2       69
```

Figure 3.6-16

```
                               LOAD SHED PRODUCTS                  PAGE  5 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                           OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
33  VWP                        82
34  CM                         96
35  RCS       16               98
36  VCS       16               97
37  SCS        8               95
38  WER        8     .54       99
39                              0
40  SRR       16     .27       67
```

Figure 3.6-17

```
                                LOAD SHED PRODUCTS                    PAGE  6 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                              OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
41  SRM       16     .54       68
42  VIL       16     2.2       83
43  STI                        74
44  HI                         72
45  M                          71
46  TVS                        70
47  SS                         73
48  LRA        8     2.2       42
```

Figure 3.6-18

```
                                LOAD SHED PRODUCTS                    PAGE  7 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                              OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
49  LRA        8     2.2       41
50  LRM        8     2.2       63
51  LRM        8     2.2       62
52  APR        8     2.2       62
53                              0
54                              0
55                              0
56                              0
```

Figure 3.6-19

```
                               LOAD SHED PRODUCTS                  PAGE  8 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
57                             0
58  UAM                       91
59  RCM                       65
60  FTM                       90
61                             0
62                             0
63  OHP       16     1.1      81
64  THP       16     1.1      77
```

Figure 3.6-20

```
                               LOAD SHED PRODUCTS                  PAGE  9 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                            OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
65  STP       16     1.1      78
66  DPA      256              80
67  SPD                       79
68  IRM                       64
69  VAD        8              57
70  RCS        8              50
71  VCS        8              49
72  CS        16              39
```

Figure 3.6-21

```
                                LOAD SHED PRODUCTS                   PAGE 10 OF 10
COMMAND: AD,*****,L,P,B,
FEEDBACK:                                                             OPER A/

(M)odify,{LINE#}       (E)nd      (C)ancel           (P)age, {N PAGES}



 N  Prod   Dta Lvl   Res    Priority
------------------------------------

------------------------------------
73  CSC                     38
74  LRA        8     2.2       40
75  LRM        8     2.2       61
```

Figure 3.6-22

3.7 Adaptation (Remote) Volume Coverage Pattern (VCP) Definitions

The WSR-88D system supports two sets of volume coverage patterns. The “local” set are stored on the RDA hard drive and are not modifiable. Local VCPs 11 and 21 are defined with PRF selection #5. The “remote” set are stored on the RPG hard drive in adaptation data. Remote VCPs 11 and 21 are defined with PRF selection #4. With different PRF selections defined for the remote and local VCP sets, the UCP operator can change the unambiguous range of the velocity data by simply switching between the remote and local VCP. Additionally, the signal-to-noise ratio (SNR) threshold for the remote VCPs will allow more weak return to be processed and displayed. To invoke one of the remote VCPs, you must ***download*** the desired VCP number to the RDA.

3.7.1 VCP 11

Remote VCP 11 is defined with a PRF selection #4 (unambiguous range of 94 nm) through 6.2 degrees elevation, while the local VCP 11 (stored on the RDA hard drive) is defined with PRF selection #5 (unambiguous range of 80 nm).

```
                            VOLUME COVERAGE PATTERN                PAGE  1 OF  2
COMMAND: AD,*****,V,*****, 11,
FEEDBACK:                                                            OPER A/

   VCP    11/ A       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV  |  SCAN  |WF|  SURV   |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #   | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
  1  0.5  3.1  19 CS   1  17    0.0  0    0.0  0    0.0  0    16   16   16   1
  2  0.5  3.2  19 CD   0   0   30.0  4  210.0  4  335.0  4    28   28   28   1
  3  1.5  3.3  18 CS   1  16    0.0  0    0.0  0    0.0  0    16   16   16   1
  4  1.5  3.2  19 CD   0   0   30.0  4  210.0  4  335.0  4    28   28   28   1
  5  2.4  2.7  22  B   1   6   30.0  4  210.0  4  335.0  4    28   28   28   1
  6  3.4  3.0  20  B   2   6   30.0  4  210.0  4  335.0  4    28   28   28   1
  7  4.3  3.0  20  B   2   6   30.0  4  210.0  4  335.0  4    28   28   28   1
  8  5.3  2.9  21  B   3  10   30.0  4  210.0  4  335.0  4    28   28   28   1
```

Figure 3.7-1

```
                            VOLUME COVERAGE PATTERN                PAGE  2 OF  2
COMMAND: AD,*****,V,*****, 11,
FEEDBACK:                                                            OPER A/

   VCP    11/ A       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV  |  SCAN  |WF|  SURV   |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #   | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
  9  6.2  2.9  21  B   3  10   30.0  4  210.0  4  335.0  4    28   28   28   1
 10  7.5  4.2  14 CD   0   0   30.0  6  210.0  6  335.0  6    28   28   28   1
 11  8.7  4.2  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 12 10.0  4.2  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 13 12.0  4.2  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 14 14.0  4.2  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 15 16.7  4.3  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 16 19.5  4.3  14 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
```

Figure 3.7-2

3.7.2 VCP 21

Remote VCP 21 is defined with a PRF selection #4 (unambiguous range of 94 nm) through 6.0 degrees elevation, while the local VCP 21 (stored on the RDA hard drive) is defined with PRF selection #5 (unambiguous range of 80 nm).

```
                            VOLUME COVERAGE PATTERN                PAGE  1 OF  2
COMMAND: AD,*****,V,*****, 21,
FEEDBACK:                                                           OPER A/

   VCP    21/ A       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV  |  SCAN  |WF|  SURV  |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #  | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
  1  0.5  1.9  32 CS   1  28    0.0  0    0.0  0    0.0  0    16   16   16   1
  2  0.5  1.9  32 CD   0   0   30.0  4  210.0  4  335.0  4    28   28   28   1
  3  1.5  1.9  32 CS   1  28    0.0  0    0.0  0    0.0  0    16   16   16   1
  4  1.5  1.9  32 CD   0   0   30.0  4  210.0  4  335.0  4    28   28   28   1
  5  2.4  1.9  32  B   2   8   30.0  4  210.0  4  335.0  4    28   28   28   1
  6  3.4  1.9  32  B   2   8   30.0  4  210.0  4  335.0  4    28   28   28   1
  7  4.3  1.9  32  B   2   8   30.0  4  210.0  4  335.0  4    28   28   28   1
  8  6.0  1.9  32  B   3  12   30.0  4  210.0  4  335.0  4    28   28   28   1
```

Figure 3.7-3

```
                            VOLUME COVERAGE PATTERN                PAGE  2 OF  2
COMMAND: AD,*****,V,*****, 21,
FEEDBACK:                                                           OPER A/

   VCP    21/ A       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV  |  SCAN  |WF|  SURV  |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #  | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
  9  9.9  2.4  25 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 10 14.6  2.4  25 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
 11 19.5  2.4  25 CD   0   0   30.0  7  210.0  7  335.0  7    28   28   28   1
```

Figure 3.7-4

3.7.3 VCP 31

The PRF selections for VCP 31 are not editable.

```
                            VOLUME COVERAGE PATTERN                PAGE  1 OF  1
COMMAND: AD,*****,V,*****, 31,
FEEDBACK:                                                           OPER A/

   VCP    31/ B       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
      LONG Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV   |  SCAN  |WF|  SURV   |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #   | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
  1  0.5  0.8  72 CS   1  63    0.0  0    0.0  0    0.0  0     0    0    0   1
  2  0.5  0.8  71 CD   0   0   30.0  2  210.0  2  335.0  2     0    0    0   1
  3  1.5  0.8  72 CS   1  63    0.0  0    0.0  0    0.0  0     0    0    0   1
  4  1.5  0.8  71 CD   0   0   30.0  2  210.0  2  335.0  2     0    0    0   1
  5  2.5  0.8  72 CS   1  63    0.0  0    0.0  0    0.0  0     0    0    0   1
  6  2.5  0.8  71 CD   0   0   30.0  2  210.0  2  335.0  2     0    0    0   1
  7  3.5  0.8  71 CD   0   0   30.0  2  210.0  2  335.0  2     0    0    0   1
  8  4.5  0.8  71 CD   0   0   30.0  2  210.0  2  335.0  2     0    0    0   1
```

Figure 3.7-5

3.7.4 VCP 32

Remote VCP 32 has the same PRF selections as the local VCP 32.

```
                            VOLUME COVERAGE PATTERN                PAGE  1 OF  1
COMMAND: AD,*****,V,*****, 32,
FEEDBACK:                                                           OPER A/

   VCP    32/ B       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV   |  SCAN  |WF|  SURV   |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|  |prf| #   | az  |prf| az  |prf| az  |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|  | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
  1  0.5  0.8  72 CS   1  64    0.0  0    0.0  0    0.0  0     4    4    4   1
  2  0.5  0.8  80 CD   0   0   30.0  5  210.0  5  335.0  5     4    4    4   1
  3  1.5  0.8  72 CS   1  64    0.0  0    0.0  0    0.0  0     4    4    4   1
  4  1.5  0.8  80 CD   0   0   30.0  5  210.0  5  335.0  5     4    4    4   1
  5  2.5  0.7  89  B   2  11   30.0  5  210.0  5  335.0  5     8    8    8   1
  6  3.5  0.7  89  B   2  11   30.0  5  210.0  5  335.0  5     8    8    8   1
  7  4.5  0.7  89  B   2  11   30.0  5  210.0  5  335.0  5     8    8    8   1
```

Figure 3.7-6

3.8 Password Control (First Level) - Agency LOCA

The first level password may be changed for security reasons. To change the first level password, the first level password must be known.

NOTE: All personnel responsible for UCP operation must know the first level password.

```
                                ADAPTATION DATA                    PAGE  1 OF  1
COMMAND: AD,*****,
FEEDBACK:                                                           OPER A/

Select One.

(AL)ert Thresholds
(AS)sociated PUP IDs and Comline Assignments
(B)ackground Map Associations Edit Screen, {PROD ID#}
(CH)ange Password, {(1, PASSWORD#1) or (2, PASSWORD#2)}
(CL)utter Maps
(G)eneration and Distribution Control, {WX MODE}
(L)oad Shedding
(M)eteorological Algorithms, {PASSWORD2}
(NB)and, {PASSWORD2}
(P)roduct Alert Pairing
(V)olume Coverage Pattern, {PASSWORD2}, {VCP}


NOTE: {PASSWORDS} may be from 1 to 8 characters long.
```

Figure 3.8-1

3.9 Periodic Status Update Frequency - Agency LOCA

This parameter determines the rate in seconds at which the “active” status screens are updated. The Periodic Status Update Frequency affects the update rate of the current archive status, RDA status, VCP time and elevation, communications, load shedding, and RPG alarms.

```
                                 UNIT CONTROL                      PAGE  1 OF  1
COMMAND: U,
FEEDBACK:                                                           OPER B/L  32

Select one.

(C)omline Connection*              (INT)erface Parameters*
(ME)ssage Display                  (L)ooptest, {MSEC}
(SE)nd Message                     (MO)nitor Performance Freq, {MIN}
(W)eather Mode Default, {MODE}     (P)eriodic Status Freq, {SEC}
(INH)ibit Status, (M)ass Storage   (O)perational Mode
(INH)ibit Status, (A)rchive III    (R)estart
(INH)ibit, (ML)OS FAS P16 Check    (SH)utdown, {(S)tandby/(O)ff}
(INH)ibit, (R)MMS, {MIN}           (T)est Mode


Looptest being Performed:       0  Monitor Performance Freq (min):       0
Weather Mode Default:           A  Periodic Status Freq (sec):          10
RPG Operational Mode:        OPER  RMMS Inhibit Interval                 0
MLOS FAS P16 Check Status    ENABL
```

Figure 3.9-1

3.10 Current Volume Coverage Pattern (VCP) - URC LOCA

Doppler velocity estimates of some weather echoes may be obscured by range-folded data due to second-trip ground clutter or overlaid multiple-trip echoes. A remedy for some of these cases is to temporarily change the pulse repetition frequency (PRF), which effectively changes the unambiguous range. When there are echoes in all quadrants and at various ranges from the radar, it may not be prudent to change the PRF for all elevation angles and all sectors. In such cases, the user may change the PRF for one or more sectors on one or more elevation angles. A temporary change of this nature is done by modifying the current volume coverage pattern (VCP).

```
                         CURRENT VOLUME COVERAGE PATTERN          PAGE  1 OF  2
COMMAND: V,                                                           RPG ALARM
FEEDBACK:                                                           OPER A/L  21

   VCP    21/ A       (M)odify, {EL#/(A)LL}     (E)nd      (C)ancel
     SHORT Pulse      (S)elect Range, {NM}      (V)el, { .97 / 1.94 }

  ELEV   |  SCAN   |WF|  SURV   |  SECT 1 |  SECT 2 |  SECT 3 |              |CLTR
no.| ang|rate|per|   |prf| #   | az   |prf| az   |prf| az   |prf| SUR| DOP| WTH|map
   | deg|rpm |sec|   | # |plse| deg | # | deg | # | deg | # | thr| thr| thr|
-------------------------------------------------------------------------------


-------------------------------------------------------------------------------
  1  0.5  1.9  32 CS  1   28    0.0  0    0.0  0    0.0  0    16   16   16   1
  2  0.5  1.9  32 CD  0    0   30.0  5  210.0  5  335.0  5    28   28   28   1
  3  1.5  1.9  32 CS  1   28    0.0  0    0.0  0    0.0  0    16   16   16   1
  4  1.5  1.9  32 CD  0    0   30.0  5  210.0  5  335.0  5    28   28   28   1
  5  2.4  1.9  32  B  2    8   30.0  5  210.0  5  335.0  5    28   28   28   1
  6  3.4  1.9  32  B  2    8   30.0  5  210.0  5  335.0  5    28   28   28   1
  7  4.3  1.9  32  B  2    8   30.0  5  210.0  5  335.0  5    28   28   28   1
  8  6.0  1.9  32  B  3   12   30.0  5  210.0  5  335.0  5    28   28   28   1
```

Figure 3.10-1

Chapter 4
Product Parameter Control

4.1 Introduction

Chapter 4 addresses the parameters that control the product appearance characteristics of selected products. These characteristics may be modified to highlight significant data values or meteorological conditions.

4.2 Gage Bias Adjustment Toggle - URC LOCA

One of the functions of the Precipitation Processing System (PPS) computes radar/rain gage biases for those sites with sufficient real-time gage data. With their Unit Radar Committee approval, sites have the option of applying the bias to their precipitation estimates. The parameter which controls whether the radar rainfall estimates are actually multiplied by the bias computed in the PPS Adjustment algorithm is the **Gage Bias Adjustment Toggle**. Until the Gage Data Support System (GDSS) is deployed at your radar, the particular setting of this parameter is irrelevant since the default bias adaptable parameter setting is 1.0 (indicating no gage/radar bias). After the GDSS is deployed, the gage data will be supplied to the RPG and the Adjustment algorithm will execute (assuming more than NSETS (see Section 6.6.2 Adjustment Precipitation) gage/radar pairs are generated each hour), even though this parameter may be set to <u>NOT APPLIED</u>. Only the graphic display of the precipitation products will be impacted by changing this parameter.

The Office of Hydrology recommends this parameter be initially set to <u>NOT APPLIED</u> until the forecasters gain confidence in the computed biases. The computed bias can be viewed on the alphanumeric terminal by looking at Page 1 of the Paired Alphanumeric Products associated with the One Hour Precipitation (OHP) and Storm Total Precipitation (STP) products or by looking at the Supplemental Precipitation Data (SPD) alphanumeric product.

```
                        SELECTION OF PRODUCT PARAMETERS            PAGE  1 OF  1
COMMAND: SE,*****,
FEEDBACK:                                                           OPER A/

Select One.

(C)ontour Product Parameters
(CE)ll Product Parameters
(L)ayer Product Parameters
(O)HP/THP Data Levels
(RC)M Product Parameters
(RE)flectivity Data Level Code Select
(S)TP Data Levels
(VA)D and RCM Height Selections
(VE)locity Data Level Code Select

(G)age Bias Adjustment Toggle:            NOT APPLIED
```

Figure 4.2-1

4.3 Contour Product Parameters - URC LOCA

By altering the data categories between the standard format product and the contour product, WSR-88D sites can highlight different phenomena or data threshold levels to meet the needs of the associated PUPs. These modifications only affect the contour products and do not affect any other RPG data processing.

4.3.1 Composite Reflectivity Contour Interval - URC LOCA

This parameter determines the interval in dBZs over which the contours are drawn for the Composite Reflectivity Contour product. The interval entry must be a multiple of 5.

4.3.2 Echo Tops Contour Base - URC LOCA

This parameter defines the base height at which the Echo Tops contours begin. The contour interval is defined by the PUP requesting the product.

4.3.3 Contour Filter Level - URC LOCA

This parameter defines the minimum number of vectors that make up a contour. Each contour is made up of many small lines (vectors). This means, for instance, if a contour only contains 3 vectors and the threshold is 4, that the contour will not be displayed.

```
                           CONTOUR PRODUCT PARAMETERS              PAGE  1 OF  1
COMMAND: SE,*****,C,
FEEDBACK:                                                           OPER A/

        (M)odify   (E)nd     (C)ancel

                Comp Ref     Echo Tops      Contour
                Contour       Contour       Filter
                Interval        Base        Level
------------------------------------------------------
Current             5          30000          4
------------------------------------------------------
MIN                 5              0          0
MAX                25          40000         12
```

Figure 4.3-1

4.4 Cell Product Parameters - URC LOCA

By altering the maximum number of cells in a product, users have control over both the visual appearance and the size of several products. Decreasing the number of cells required for transmission can decrease the product transmission time and therefore reduce potential narrowband loadshedding. In addition, by simplifying the display, it may also enhance the operator's ability to interpret products. However, caution should be exercised when limiting the number of cells included in the product. Decreasing the number of cells displayed may hide information on potentially significant storms.

This menu is used to adjust the maximum number of storm cells in the STI (Storm Track Information), SS (Storm Structure), and Hail alphanumeric products and the STI, Hail, and Combined Attribute Tables that are disseminated to users. The primary reason for limiting the number of storm cells in products is to reduce the product sizes and, hence, reduce the chances of narrowband loadshedding. The parameters in this menu do ***NOT*** affect the number of storm cells identified and tracked or the number of storms cells in the STI and Hail graphic products or overlays.

When changing these parameters, one must consider that ***all*** users of the product will be affected. A compromise between the number of 'useful' storm cells (in the part of the product) and narrowband loadshedding should be the goal.

If narrowband loadshedding is a problem for users requesting some or all of the SS, STI, Hail Index (HI), and Composite Reflectivity (CR) products, lower the values for all products in this menu by the number of cells on one page of the product and observe the results. It is ***NOT*** recommended that the number of cells for any product (menu row) be reduced to less than 20 cells. If you’ve made appropriate changes to this menu and narrowband loadshedding is still a problem, consider reducing the number of product requests (from the Associated PUPs).

In the range of values, the upper limit is 100, which is the same as the upper limit on the maximum number of storm cells per volume scan (see the STORM CELL CENTROIDS Algorithm adaptable parameters). The lower limit for each parameter is the number of storm cells which fit on the first page of that part of the product. For example, there can be up to 10 storm cells on the first page of the Hail alphanumeric product.

To most efficiently reduce the product sizes, increase or decrease the maximum number of storm cells by the number of storm cells which fit on whole pages of (or part of) a product. The number of storm cells which fit on each page is equal to the lower limit in the range of acceptable values, except for the STI alphanumeric product. For example, the number of storm cells per page of the

```
                           CELL PRODUCT PARAMETERS                PAGE  1 OF  1
COMMAND: SE,*****,CE,
FEEDBACK:                                                          OPER A/

     (M)ODIFY    (E)ND     (C)ANCEL

     DESCRIPTION                                          RANGE      VALUE
    ______________________________________________________________________


     MAXIMUM # OF CELLS IN STI ALPHANUMERIC PRODUCT      7 - 100      34
     MAXIMUM # OF CELLS IN SS ALPHANUMERIC PRODUCT      10 - 100      40
     MAXIMUM # OF CELLS IN HAIL ALPHANUMERIC PRODUCT    10 - 100      40
     MAXIMUM # OF CELLS IN STI ATTRIBUTE TABLE           6 - 100      36
     MAXIMUM # OF CELLS IN COMBINED ATTRIBUTE TABLE      4 - 100      32
     MAXIMUM # OF CELLS IN HAIL ATTRIBUTE TABLE          6 - 100      36

    ______________________________________________________________________
```

Figure 4.4-1

Hail Attribute Table is 6. For the STI alphanumeric product, the first page lists up to 7 storm cells, but each additional page can list up to 9 storm cells.

The storm cells for each (part of a product) are sorted by a 'severity' attribute. For example, in the STI product the storm cells are sorted by cell-based VIL, and secondly, maximum reflectivity. When the number of storm cells identified exceeds the maximum number of storm cells in a particular (part of a) product, the storm cells nearest the top of the sorted list (i.e. 'the most severe' storm cells) are included.

4.5 Layer Product Parameters

This menu allows the specification of the layer definitions for the Layered Composite Reflectivity products. The design allows for four entries to define the three layers. Consequently, the first specified height (L0) defines the bottom of the first layer, the second specified height (L1) defines the top of the first layer and the bottom of the second layer, the third specified height (L2) delineates the top of the second layer and the bottom of the third layer and the fourth specified height (L3) defines the top of the third layer.

NOTE

The lowest height definition (L0) on this menu **DOES NOT** affect the Layered Composite Reflectivity - AP Removed (APR) product. However, changing the second height definition (L1) will change the top of the lowest layer for the LRA and all other layered products.

Designed to support national layer composite maps, the height and depth definitions of the second and third layers are standardized as 24-33 kft and 33-60 kft, respectively. Because of this requirement, the second, third and fourth (L1, L2, and L3) height definitions fall under the OSF LOCA to ensure these layer definitions support the national FAA aerospace monitoring program. However, since this program no longer uses the lowest layer Layered Composite Reflectivity product to build national radar mosaic products, the base of the lowest layer height specification is now under the URC LOCA.

```
                              LAYER PRODUCT PARAMETERS               PAGE  1 OF  1
COMMAND: SE,*****,L,
FEEDBACK:                                                             OPER A/

         (M)odify    (E)nd    (C)ancel

                 LAYER REFLECTIVITY
          L0 Hgt   L1 Hgt   L2 Hgt   L3 Hgt      Rng
          Ft MSL   Ft MSL   Ft MSL   Ft MSL      km
-----------------------------------------------------------
Current      0       24       33       60        460
-----------------------------------------------------------
MIN          0        6       12       18         40
MAX         52       58       64       70        460
```

Figure 4.5-1

NOTE

ONLY the lowest layer height definition (L0) may be modified under the direction of the URC. The lowest layer height definition **must** be defined above the station elevation (MSL) and the layer depth (L1 - L0) must be at least 6000ft.

4.6 One / Three Hour Precipitation (OHP/THP) Product Data Levels - URC LOCA

The displayable range of precipitation accumulation and quantization of accumulations into each color level can be changed by modifying the current displayable precipitation accumulation values. This functionality enables WSR-88D sites to modify the precipitation accumulation values and quantizations to meet local data requirements.

The One-hour Precipitation Accumulation (OHP) and Three-hour Precipitation Accumulation (THP) product data levels are controlled via the same menu, and therefore have the same accumulation and quantization values. In addition, the User Selectable Precipitation (USP) product data levels are controlled by this menu if the USP maximum rainfall is less than the Code 16 value (default = 8.00 inches). If the USP maximum rainfall exceeds the Code 16 value, the USP product data levels are controlled by the Storm Total Precipitation Accumulation (STP) data level menu (see section 4.9). The displayable data levels range from 0.05 to 12.70 inches with a quantization resolution of 0.05 inches.

Modifications to these displayable product data levels ***will affect all*** associated PUPs and nonassociated users of precipitation accumulation data. Coordination with affected RFCs is recommended.

```
                              OHP/THP DATA LEVELS                 PAGE  1 OF  1
COMMAND: SE,*****,O,
FEEDBACK:                                                          OPER A/

(M)odify   (E)nd     (C)ancel                CODE        CURRENT(Inches)
                                               1               ND
                                               2           >   0.00
                                               3               0.10
                                               4               0.25
                                               5               0.50
                                               6               0.75
   note: Permissible value range               7               1.00
         is 0.05 to 12.70 inches               8               1.25
         in multiples of 0.05 inches.          9               1.50
         The value entered represents the     10               1.75
         minimum value of the data level.     11               2.00
                                              12               2.50
                                              13               3.00
                                              14               4.00
                                              15               6.00
                                              16               8.00
```

Figure 4.6-1

4.7 Radar Coded Message (RCM) Product Parameters

This menu defines the parameters for the RCM.

```
                            RCM PRODUCT PARAMETERS                PAGE  1 OF  1
COMMAND: SE,*****,RC,
FEEDBACK:                                                          OPER A/

  Select one:   (M)odify   (E)nd   (C)ancel
                                                   RCM GENERATION
  RNG THRSH |RESTRICT|  #  |   TIME(min)    |   TIME 1   |    TIME 2   | EDITABLE
    (dBZ)   |CLASS IV|CENT.| BEG EDIT| EDIT| Y/N | (min)|  Y/N | (min)|  PUP ID
--------------------------------------------------------------------------------
CUR  20.0      Y       12        1        1   Y     20      Y     50     RGOP
--------------------------------------------------------------------------------
MIN -33.0               0        1        1          0             0
MAX  94.0              20        9       30         59            59
```

Figure 4.7-1

4.8 Reflectivity Data Level Code Select (RCM)

This menu defines the reflectivity values for the RCM product, only.

```
                    RCM REFLECTIVITY DATA LEVEL CODE SELECT        PAGE  1 OF  1
COMMAND: SE,*****,RE,
FEEDBACK:                                                          OPER A/

(M)odify    (E)nd     (C)ancel                CODE        CURRENT
                                                0        ≤    15.0
                                                1        ≤    30.0
                                                2        ≤    40.0
                                                3        ≤    45.0
                                                4        ≤    50.0
                                                5        ≤    55.0
                                                6        >    55.0
```

Figure 4.8-1

4.9 Storm Total Precipitation (STP) Product Data Levels - URC LOCA

The Storm Total Precipitation Accumulation (STP) product data levels are controlled by this menu. In addition, the User Selectable Precipitation (USP) product data levels are controlled by this menu if the USP maximum value exceeds the Code 16 value (default = 8.00 inches) for the OHP/THP data levels. If the USP maximum rainfall is less than the OHP/THP Code 16 value, the USP product data levels are controlled by the OHP/THPdata level menu (see section 4.6). The displayable range of precipitation accumulation and quantization of accumulations into each color level can be changed by modifying the current displayable precipitation accumulation values. This functionality enables modification of the precipitation accumulation values and quantizations to meet local data requirements. The displayable data levels range from 0.1 to 25.4 inches, with a quantization resolution of 0.1 inches.

Modifications to these displayable product data levels ***will affect all*** associated PUPs and nonassociated users of precipitation accumulation data. Coordination with affected RFCs is recommended.

```
                                  STP DATA LEVELS                  PAGE  1 OF  1
COMMAND: SE,*****,S,
FEEDBACK:                                                           OPER A/

(M)odify   (E)nd     (C)ancel                CODE        CURRENT(Inches)
                                               1               ND
                                               2           >   0.0
                                               3               0.3
                                               4               0.6
                                               5               1.0
                                               6               1.5
   note: Permissible value range               7               2.0
         is from 0.1 to 25.4 inches            8               2.5
         in multiples of 0.1 inches.           9               3.0
         The value entered represents the     10               4.0
         minimum value of the data level.     11               5.0
                                              12               6.0
                                              13               8.0
                                              14              10.0
                                              15              12.0
                                              16              15.0
```

Figure 4.9-1

4.10 Velocity Azimuth Display (VAD) and RCM Height Selections - Delegated URC Authority

This screen is used to define the heights (MSL) of the VAD-derived wind estimates for the Radar Coded Message (RCM) and the VAD Wind Profile (VWP) products.

4.10.1 Delegated Authority Restrictions

RCM wind direction and speed, as output from the VAD algorithm, shall be reported at 1,000 foot increments from the nearest 1,000 ft MSL above the radar level (SURFACE) to 10,000 feet MSL; then at 2,000 foot increments from 12,000 to 20,000 feet MSL; and at the additional levels of 25,000; 30,000; 35,000 and 50,000 feet MSL. The VAD/RCM heights (up to 19 height values) must be specified as described herein to maintain national RCM wind height consistency. For radars with an elevation above 1000 ft MSL, the change authority is granted to the URC (or Agency field office where no URC exists) for the reassignment of the unused VAD/RCM heights to VAD only heights.

4.10.2 Supplemental Information - VWP Display Heights

The VAD Wind Profile (VWP) Product has the capability to display up to 30 heights. The heights are specified as up to 19 combination VAD and RCM heights (designated by a “B” on the UCP edit screen) and the remaining, up to a total of 30 heights, as VAD only (designated by a “V”).

In the example UCP screen shown in Fig. 4.10-1, the radar elevation is 2955 ft MSL. Therefore, the lowest VAD/RCM height defined on the edit screen is the 3 kft height MSL (45 ft above the surface for this location). The “unused” VAD/RCM (B) heights (1 and 2 kft) were reassigned as VAD only (V) height selections at 21 kft and 52 kft, respectively.

```
                        VAD AND RCM HEIGHT SELECTIONS             PAGE  1 OF  1
COMMAND: SE,*****,VA,
FEEDBACK:                                                          OPER A/

         (M)odify, {STARTING HEIGHT}   (E)nd   (C)ancel


  1    |  2    |  3  B |  4  B |  5  B |  6  B |  7  B |  8  B |  9  B | 10  B |
 11  V | 12  B | 13  V | 14  B | 15  V | 16  B | 17  V | 18  B | 19  V | 20  B |
 21  V | 22  V | 23    | 24  V | 25  B | 26  V | 27    | 28  V | 29    | 30  B |
 31    | 32    | 33    | 34    | 35  B | 36    | 37    | 38    | 39    | 40  V |
 41    | 42    | 43    | 44    | 45  V | 46    | 47    | 48    | 49    | 50  B |
 51    | 52  V | 53    | 54    | 55    | 56    | 57    | 58    | 59    | 60    |
 61    | 62    | 63    | 64    | 65    | 66    | 67    | 68    | 69    | 70    |


Heights are represented in Kft.

Note: A selection of V indicates a VAD height only, while a selection of B
      indicates both a VAD and RCM height. A total of 30 VAD heights may be
      selected of which 19 may be both VAD and RCM height selections.
```

Figure 4.10-1

4.11 Velocity Data Level Code Select - URC LOCA

The displayable range of velocities (maximum inbound to maximum outbound) and the quantization of velocities into each color level can be changed by modifying the velocity threshold tables. The WSR-88D provides for eight velocity threshold tables to define the base velocity product's display values. The eight different tables are needed to account for the velocity measurement increment being used and the weather mode. This enables WSR-88D sites to modify the velocity data maximum display values and quantizations to meet local velocity data requirements. For example, sites that are expecting very high sustained winds (e.g., a hurricane is approaching) may elect to modify the 16-level velocity threshold table to display wind speeds from -80 to +80 kts. This modification of the quantization levels may de-emphasize weak velocity values, and help to better differentiate tropical cyclone and hurricane force wind speed thresholds.

Modifications to the velocity product data levels ***will affect all*** associated PUPs and nonassociated users of velocity data.

```
                        VELOCITY DATA LEVEL CODE SELECT            PAGE  1 OF  1
COMMAND: SE,*****,VE,
FEEDBACK:COMMAND EXECUTED - SE,*****,VE,D,4                         OPER A/

(D)isplay, <CODE TABLE ID#>                  CODE       CURRENT
(M)odify    (E)nd     (C)ancel                 1            THR
                                               2           -64.
                                               3           -50.
                                               4           -36.
Velocity threshold table:  4                   5           -26.
Wx Mode: A  Velocity Lvls: 16                  6           -20.
Doppler Res. 0.5M/S  1 KT                      7           -10.
                                               8            -1.
                                               9             0.
                                              10            10.
NOTE: If <CODE TABLE ID#> and its             11            20.
      associated Doppler interval,            12            26.
      weather mode and code levels            13            36.
      are not known, see HELP                 14            50.
      screen.                                 15            64.
                                              16            RF
```

Figure 4.11-1

4.11.1 Velocity Data Level Tables

There are eight velocity data level tables stored at the RPG. Each table defines the velocity quantizations for a particular weather mode and velocity measurement increment. The VELOCITY DATA LEVEL CODE SELECT HELP screen shown below defines the Code Table ID # for each table.

```
                   VELOCITY DATA LEVEL CODE SELECT HELP            PAGE  2 OF  2
COMMAND:
FEEDBACK:                                                           OPER A/


       Code Table      Doppler        Associated       Default
       ID Number      Res (m/s)       Weather Mode   Number of Levels
       ----------     ---------       ------------   ----------------
           4            0.5           Precipitation       16
           5            0.5           Precipitation        8
           6            1.0           Precipitation       16
           7            1.0           Precipitation        8
          26            0.5           Clear               16
          27            0.5           Clear                8
          28            1.0           Clear               16
          29            1.0           Clear                8
```

Figure 4.11-2

4.11.2 Supplemental Information

When collecting velocity data using the 1 m/s (1.94 kt) velocity measurement increment, the Base Velocity (16 data level), Velocity Cross Section (16 data level), and Storm Relative Mean Radial Velocity data quantizations are defined using Code Table ID Number 6. However, when collecting velocity data using the .5 m/s (.97 kt) velocity measurement increment, the Base Velocity (16 data level) and Velocity Cross Section (16 data level) data quantizations are defined using Code Table ID Number 4, while the Storm Relative Mean Radial Velocity data quantizations are defined using Code Table ID Number 15, which is not editable via the UCP.

Chapter 5

Communications Control Parameters

5.1 Introduction

Narrowband communications control is exercised through the parameter settings defined in this chapter. Every WSR-88D unit has different narrowband communications requirements; therefore, many of the specific parameter settings contained in this chapter will ***NOT*** be the same as the settings at your local site.

Each site is required to maintain a Communications Documentation Notebook to provide a ready reference to facilitate communications problem identification and resolution. The information required for this notebook is provided by the WSR-88D Hotline and should be closely monitored by the local focal point.

NOTE

This chapter is provided for reference only, **DO NOT MODIFY YOUR NARROWBAND COMMUNICATIONS PARAMETERS** TO REFLECT THE ENTRIES PRESENTED HERE.

5.2 Associated PUP IDs and Comline Assignments

This menu assigns the four-letter PUP identifier to each associated narrowband communications line number. These PUP IDs are displayed on the Communications Control, Communications Status, and Narrowband Status menus, as well as the PUP/RPGOP Status menu.

```
                     ASSOC PUP IDS AND COMLINE ASSIGNMENTS          PAGE  1 OF  1
COMMAND: AD,*****,AS,
FEEDBACK:                                                            OPER A/

  (M)odify    (E)nd    (C)ancel

  LINE: ID     LINE: ID     LINE: ID     LINE: ID     LINE: ID
  ------------------------------------------------------------
     5: PUP1      6: PUP2      7: PUP3      8: PUP4      9: PUP5
    10: PUP6     11: PUP7     12: PUP8     13: PUP9     14: PU10
    15: PU11     16: PU12     **:          **:          **:
    **:          **:          **:          **:          **:
    **:          **:          **:          **:          **:
    **:          **:          **:          **:          **:
    **:          **:          **:          **:          **:
    **:          **:          **:          **:          **:
    **:
```

Figure 5.2-1

5.3 Narrowband Reconfiguration Control

Upon initial setup and whenever communications ports are expanded, the narrowband configuration will require modification using this menu. Additionally, communications security requirements may necessitate password changes for dial-in ports. The OSF will authorize site personnel to modify the narrowband configuration when these modifications are required.

```
                              RECONFIGURATION CONTROL               PAGE  1 OF  6
COMMAND: AD,*****,NB,*****,RE,
FEEDBACK:                                                            OPER A/L  21

(M)odify,{NO}      (E)nd            (C)ancel          (P)age,{N PAGES}
(I)nsert,{NO}      (D)elete,{NO}    (U)pdate,{Y/N}

NO LINE  DEVICE  COMMS   LINE    BAUD   LINE    PUP ID/  DISTRIB  TIME LIMIT
   NUM   ID MNE  OPTION  CLASS   RATE   TYPE    PASSWD*  METHOD   MINUTES
-----------------------------------------------------------------------------
------------------------------------------------------------------------------
 1   1    J01      Y     RPGOP  56000  DEDIC     RPOP
 2   2    J02      N     NAPUP   9600  DIALIN    NWIP                60
 3   3    J03      N     NAPUP  14400  DIALIN    RDAT                60
 4   4    J04      N     NAPUP  14400  DIALIN    LINE                60
 5   5    J05      N     APUP   14400  DEDIC     PUP1
 6   6    J06      N     APUP    9600  DEDIC     PUP2
 7   7    J07      N     APUP   14400  DEDIC     PUP3
 8   8    J08      N     APUP   14400  DEDIC     PUP4

                        * PUP ID WHEN CLASS IS APUP, OTHERWISE PORT PASSWORD
```

Figure 5.3-1

```
                              RECONFIGURATION CONTROL              PAGE  1 OF  6
COMMAND: AD,*****,NB,*****,RE,
FEEDBACK:                                                           OPER A/L  21

(M)odify,{NO}      (E)nd              (C)ancel           (P)age,{N PAGES}
(I)nsert,{NO}      (D)elete,{NO}      (U)pdate,{Y/N}

NO LINE  DEVICE  COMMS  LINE    BAUD   LINE   PUP ID/  DISTRIB  TIME LIMIT
   NUM   ID MNE  OPTION CLASS   RATE   TYPE   PASSWD*  METHOD   MINUTES
--------------------------------------------------------------------------------


--------------------------------------------------------------------------------
 9    9    J09      Y     APUP   14400  DEDIC    PUP5
 10  10   J10       Y     APUP   14400  DEDIC    PUP6
 11  11   J11       Y     APUP   14400  DEDIC    PUP7
 12  12   J12       Y     APUP    9600  DEDIC    PUP8
 13  13   J13       N     APUP    9600  DEDIC    PUP9
 14  14   J14       N     APUP   14400  DEDIC    PUP10
 15  15   J15       Y     APUP   14400  DEDIC    PUP11
 16  16   J16       Y     APUP    9600  DEDIC    PUP12
```

Figure 5.3-2

5.4 Narrowband Dial-in Port Control

This menu allows password and product availability control for individual dial-in ports.

```
                         DIAL-IN PORT CONTROL EDIT SCREEN          PAGE  1 OF  6
COMMAND: AD,*****,NB,*****,DI,
FEEDBACK:                                                           OPER A/

(M)odify,{NO}      (E)nd        (C)ancel     (P)age,{N PAGES}

NO       LINE       PORT        DISTRIB      TIME LIMIT
         NUM        PASSWD      METHOD       MINUTES
-------------------------------------------------------


-------------------------------------------------------
 1        1                                    60
 2        2                                    60
 3        3         RDAT                       60
 4        4         LINE                       60
```

Figure 5.4-1

5.5 Authorized Dial-in Users

This menu is used to specify those PUPs authorized access to the RPG and to assign site-specific dial-in user passwords. Changes to this screen, including instructions to make the modifications, are provided by the WSR-88D Hotline.

```
                        AUTHORIZED DIAL-IN USERS SCREEN            PAGE  1 OF 54
COMMAND: AD,*****,NB,*****,AU,
FEEDBACK:                                                            OPER A/

(M)odify,{NO}      (E)nd             (C)ancel      (P)age,{N PAGES}
(I)nsert,{NO}      (D)elete,{NO}

NO      USER        USER          DISCONNECT
        ID          PASSWD        OVERRIDE
--------------------------------- ----------

--------------------------------- ----------
  1        9        OSFOTB            Y
  2       10        NORMAN            N
  3       11        CINDYA            Y
  4       12        WMICAH            N
  5       13        ASHLEY            Y
  6       14        PEPPER            N
  7       15        PUNKIN            Y
  8       16        RACHEL            N
```

Figure 5.5-1

```
                        AUTHORIZED DIAL-IN USERS SCREEN            PAGE  2 OF 54
COMMAND: AD,*****,NB,*****,AU,
FEEDBACK:                                                            OPER A/

(M)odify,{NO}      (E)nd             (C)ancel      (P)age,{N PAGES}
(I)nsert,{NO}      (D)elete,{NO}

NO      USER        USER          DISCONNECT
        ID          PASSWD        OVERRIDE
--------------------------------- ----------

--------------------------------- ----------
  9       21        FUTURE            N
 10       22        NOPASS            Y
 11       23        TIMER9            N
 12       24        NEXRAD            Y
 13       25        RADARS            N
 14       26        ABCDEF            Y
 15       27        WHATIF            N
 16       28        LEADER            Y
```

Figure 5.5-2

5.6 Interface Parameters

This menu defines timeout and retry times for the wideband and narrowband communications interfaces. Additionally, the Rain Gage Data Acquisition Computer (RGDAC) phone numbers are specified here. The RGDAC phone number definitions are under the Agency LOCA.

```
                                INTERFACE PARAMETERS              PAGE  1 OF  1
COMMAND: U,INT,                                                        RPG ALARM
FEEDBACK:                                                           OPER A/R  21
(M)odify    (E)nd     (C)ancel
       Retries            Timeouts               Phone #'s
    NB         WB       NB        WB        RGDAC1         RGDAC2
----------------------------------------------------------------------------
     2          2       120        10       4518           3055
-----------------------------------------------------------------------------
NB - Narrow Band           WB - Wide Band
RGDACn - Rain Gauge Data Aquisition Computer

Special Phone # Characters Allowed:
    Pause:     K, k, less than, comma
    Dial Wait: W, w, colon
    Ignored:   period, dash, parenthesis
```

Figure 5.6-1

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Chapter 6

Meteorological Algorithm Parameters

6.1 Introduction

Chapter 6 presents the default setting for each of the WSR-88D meteorological algorithm adaptable parameters.

Environmental-condition sensitive algorithm parameters (e.g. 0 and -20 degree Celsius heights, nominal clutter area, default storm motion, etc.,) should be routinely modified to improve algorithm performance.

CAUTION

Caution is warranted; modifications to some algorithm parameters may have a significant detrimental impact on the performance, accuracy, and reliability of the target algorithm and related products, as well as on RPG system performance.

Algorithm research activity ***MUST NOT*** be done on the WSR-88D system, but can be accomplished using Archive II data and the SOO/SAC workstations running the WATADS software package.

6.2 Environmental Data

6.2.1 Environmental Winds - Agency LOCA

The Environmental Winds Table is a list of wind speeds and directions at 1000 ft intervals from the surface to 70,000 ft MSL. The Velocity Dealiasing Algorithm uses information from the environmental winds table when there is no continuity available to dealias suspect velocity estimates. With the Auto VAD Update feature enabled, the wind speeds and directions are updated every volume scan by the Velocity Azimuth Display Task. Additionally, manual modification of this table is possible. The Environmental Winds Edit Screen is used to observe the current values being used by the algorithm, as well as to modify the values to ones that better reflect the ambient wind field.

Occasionally aliased velocity data is not handled well by the Velocity Dealiasing Algorithm. One possible cause may be that the current Environmental Winds Table does not accurately reflect the ambient wind field. When this occurs, use other reliable sources for upper air data and manually update the Environmental Winds Table and ensure the Auto VAD Update Function is enabled (on).

```
                        ENVIRONMENTAL WINDS EDIT SCREEN            PAGE  1 OF  5
COMMAND: E,E,
FEEDBACK:                                                           OPER A/

  (M)odify, {N}    (E)nd    (C)ancel    (A)uto Vad Update
  (U)nits Toggle {m/s vs kts}    (I)nitialize Table,{Start level, End level} *

         N    HGT(kft msl)     MEAN DIR (deg)   MEAN SPD(kts) Auto Update: ON
        -----------------------------------------------------


        -----------------------------------------------------
  N     HGT       MEAN DIR   MEAN SPD  |  N     HGT       MEAN DIR   MEAN SPD
---------------------------------------+----------------------------------------
  1     1.3       32767.0    32767.0      8     8.3       32767.0    32767.0
  2     2.3       32767.0    32767.0      9     9.3       32767.0    32767.0
  3     3.3       32767.0    32767.0     10    10.3       32767.0    32767.0
  4     4.3       32767.0    32767.0     11    11.3       32767.0    32767.0
  5     5.3       32767.0    32767.0     12    12.3       32767.0    32767.0
  6     6.3       32767.0    32767.0     13    13.3       32767.0    32767.0
  7     7.3       32767.0    32767.0     14    14.3       32767.0    32767.0
NOTE: Start level must be less than or equal to End level.  Only integer values
      are allowed for this command.
```

Figure 6.2-1

6.2.2 Hail Temperatures/Default Storm Motion - URC LOCA

The Hail Detection Algorithm predicts the probability of hail, severe hail and hail size by searching for high reflectivity values which exist above the freezing level. For this algorithm to provide the most accurate data, the radar operator must provide the altitude of the 0°C and -20°C isotherms, based on current sounding data.

The tracking and forecast algorithms assign the default storm motion to cells for the first volume scan that storm cells develop (i.e. the initial convection within the radar umbrella). Therefore, the **DEFAULT STORM SPEED** and **DIRECTION** should be changed ***before*** convection starts and should represent the expected motion of storm cells at the beginning of the event. After the first volume scan, the vector-average motion of all storm cells in the previous volume scan is assigned to new cells. If at the start of convection, the default storm motion is unrepresentative of the actual storm motion, the performance of the tracking and forecasting algorithms may initially be decreased. This could initially degrade the accuracy of cell trend data and storm relative velocity products. If storm cells have already been identified and tracked (for a volume scan), changing these parameters will have no effect until the next convective event.

```
                HAIL TEMPERATURES/DEFAULT STORM MOTION             PAGE  1 OF  1
COMMAND: E,H,
FEEDBACK:                                                           OPER A/

(M)odify        (E)nd        (C)ancel

ITEM              ALTITUDE MSL                 DEFAULT STORM MOTION
               0 DEG C      -20 DEG C          DIRECTION      SPEED
------------------------------------------------------------------------------
CURRENT        10.5 Kft       20.0 Kft           270 Deg       10.0 Kts
------------------------------------------------------------------------------
MIN             0.0            0.0                 0            0.0
MAX            70.0           70.0               360           99.9
```

Figure 6.2-2

6.3 Centroids of Components and Storms

The Storm Cell Centroids algorithm is the part of the Storm Cell Identification and Tracking (SCIT) algorithm which identifies storm cells and their components. The largest difference between the SCIT algorithm and the Storm Series algorithms is that instead of defining the volume of convective storms, this algorithm identifies the individual high reflectivity cores or cells within convective storms. The SCIT algorithm's ability to identify and track cells within a larger area of significant reflectivity (e.g. squall line) is significantly improved over the Storm Series (pre-Build 9.0) algorithm package. However, SCIT will still have difficulty identifying (and tracking) cells if a large area of significant reflectivity is nearly constant with no substantial reflectivity maximum, as in a uniform squall line or a stratiform area of moderate to heavy rain.

6.3.1 Overview of SCIT

First, to identify cells, the algorithm combines segments (from the Storm Cell Segments algorithm) into two-dimensional potential components. The segment must overlap radially by at least the **Threshold (Segment Overlap)** and be on adjacent radials which are less than the **Threshold (Az Separation)** apart. Since there are multiple reflectivity thresholds used to find segments, ***only segments found on the same elevation scan with the same reflectivity threshold are combined***. The **Threshold (Mx Pot Comp/Elev)** is the maximum number of potential components which can be saved per reflectivity threshold per elevation scan. The potential component is labeled a component if it has a minimum of at least the **Threshold (# Segment/Comp)** number of segments and has a minimum area of **Threshold (Component Area)** for its reflectivity threshold.

Next, a search is done for overlapping components of different reflectivity thresholds on the same elevation scan to identify centroids. A centroid is the mass-weighted center of a component or cell. If the centroid of a component found with a higher reflectivity threshold falls within the boundaries of another component, the component found with the higher reflectivity threshold is saved, and the other is discarded. After this process, the **Threshold (Max Comp/Elev)** value is the final number of components per elevation scan which can be saved.

Then the components are vertically correlated, i.e. assigned to the same cell. The centroids of the components at adjacent elevation scans are compared for horizontal proximity. For each component, the distance from the center of every component in the next highest elevation scan is compared until a component is found within a specified search radius, **Threshold (Search Radius #1)**. If no match is found for a component, then the search radius is increased to **Threshold (Search Radius #2)**, and the comparison is done again. This process is repeated if necessary with **Threshold (Search Radius #3)**. At this point, **Threshold (Max Detect Cells)** is the maximum number of cells saved (in a volume scan).

If two cells' centroids are within spacial proximity, the cells are merged. To merge two cells, their centroids must be within a specified horizontal distance, **Threshold (Horizontal Merge)**, and their bases and tops must be within a specified vertical and angular separation, **Threshold (Height Merge)** and **Threshold (Elevation Merge)**, respectively. When merging two cells, one cell's components are added to the other cell, and a new centroid is calculated. Next, to reduce the crowding, when two cells are still within spacial proximity, the cell with the lesser Cell-based VIL is deleted. To delete one of the cells, either of their centroids must be no more than **Threshold (Horizontal Delete)** apart. Or, the difference in their cell depths must be greater than the **Threshold (Depth Delete)** and their centroids must be no more than twice the **Threshold (Horizontal Delete)** apart. The final maximum number of cells (after the merging and deletion processes) in a volume scan is **Threshold (Max Cells/Vol)**.

6.3.2 Threshold Maximum VIL - URC LOCA

The **Threshold (Maximum VIL)** value is the maximum Cell-based VIL which will be computed or displayed. The Cell-based VIL is an estimate of the liquid water through a storm cell, based on the cell’s component’s maximum reflectivities. The purpose of the **Threshold (Maximum VIL)** is to mitigate hail contamination of the Cell-based VIL. However, since the Cell-based VIL can be used as a hail predictor, the default value is set at it’s maximum value. The value can be lowered to prevent extremely high Cell-based VILs due to hail contamination. For example, the threshold can be set equal to 80 kg/m^2, the same as the MVT - Max VIL Threshold in the VIL algorithm. ***This adaptable parameter only affects the Cell-based VIL***.

```
                              STORM CELL CENTROIDS                 PAGE  1 OF  2
COMMAND: AD,*****,M,*****,CE,
FEEDBACK:                                                           OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                              RANGE              VALUES    UNITS
--------------------------------------------------------------------------------
THRESH (# SEGMENTS/COMP)                 1 - 4                 2      -
THRESH (SEGMENT OVERLAP)                 0 - 5                 2      BINS
THRESH (AZ SEPARATION)                 1.5 - 3.5             1.5      DEG
THRESH (MX POT COMP/ELEV)               10 - 100              70      -
THRESH (MAX COMPS/ELEV)                 20 - 120             120      -
THRESH (MAX DETECT CELLS)               20 - 130             130      -
THRESH (MAX CELLS/VOL)                  20 - 100             100      -
THRESH (MAXIMUM VIL)                     1 - 120             120      KG/M**2
THRESH (COMPONENT AREA #1)            10.0 - 30.0           10.0      KM**2
       (COMPONENT AREA #2)            10.0 - 30.0           10.0      KM**2
       (COMPONENT AREA #3)            10.0 - 30.0           10.0      KM**2
       (COMPONENT AREA #4)            10.0 - 30.0           10.0      KM**2
       (COMPONENT AREA #5)            10.0 - 30.0           10.0      KM**2
```

Figure 6.3-1

```
                              STORM CELL CENTROIDS                 PAGE  2 OF  2
COMMAND: AD,*****,M,*****,CE,
FEEDBACK:                                                           OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                              RANGE              VALUES    UNITS
--------------------------------------------------------------------------------
THRESH (COMPONENT AREA #6)            10.0 - 30.0           10.0      KM**2
       (COMPONENT AREA #7)            10.0 - 30.0           10.0      KM**2
THRESH (SEARCH RADIUS #1)              1.0 - 10.0            5.0      KM
       (SEARCH RADIUS #2)              1.0 - 12.5            7.5      KM
       (SEARCH RADIUS #3)              1.0 - 15.0           10.0      KM
THRESH (DEPTH DELETE)                  0.0 - 10.0            4.0      KM
THRESH (HORIZONTAL DELETE)             3.0 - 30.0            5.0      KM
THRESH (ELEVATION MERGE)               1.0 - 5.0             3.0      DEG
THRESH (HEIGHT MERGE)                  1.0 - 8.0             4.0      KM
THRESH (HORIZONTAL MERGE)              5.0 - 20.0           10.0      KM
```

Figure 6.3-2

6.4 Combined Shear

The Combined Shear algorithm is intended to assist the user in identifying shear regions such as along gust fronts and in mesocyclones. It is especially useful in that, unlike the human operator, it isn't keying off color contrasts. The combined shear algorithm computes estimates of shear along a radial and also gate-to-gate tangentially between two radials. These two measures are mapped onto separate Cartesian grids whose resolutions are controlled by the domain resolution adaptable parameter, **DOR**. These two measures are combined by taking the square root of the sum of the squares of each estimate. The combined shear may be smoothed by applying an equally weighted two-dimensional filter to the gridded field. The filter is always centered on a grid point. Thus, it is required to have odd-numbered integer dimensions. The adaptable parameter **NFL** adjusts the size of the filter and is specified as the total number of points in the filter. For example, a value of 25 for **NFL** indicates that a 5 x 5 point filter is being used. Because this algorithm is CPU-intensive, the user is restricted to applying it to only one elevation at a time. The default elevation scan beginning with Build 9 is the 0.5 degree elevation scan. Each unique elevation angle is numbered sequentially from 1 to the highest number in the VCP. For VCP 21 the highest valid number is 9 and for VCP 11 the highest valid number is 14. The adaptable parameter **ELEV** being set to 1 points to the 0.5 degree elevation. Once a combined shear field is generated, the Combined Shear Contour product may be generated. The adaptable parameter **CI** controls the contour interval and is expressed as an integer multiple of 0.001 s^{-1}. Note that the Combined Shear Product's legend displays the shear categories as 10 times the integer times 10^{-4} s^{-1}.

Changing the adaptable parameters **DOR** and **NFL** affects the magnitude of the shear displayed, the granularity and resolution of the data, and processing load on the RPG. The algorithm computes the average of all radial and tangential shears in their respective Cartesian grids. Increasing the value of **DOR** increases the number of shear values that are averaged together, which effectively lowers the maximum value of shears that will be displayed. Conversely, decreasing **DOR** will cause fewer shear values to be mapped to any particular grid location. With fewer values averaged together, greater extremes will be displayed. At 0.5 km resolution there is not enough resolution in the radial data to map a shear value to each Cartesian grid point. This results in a grainy appearance in the product. However, increasing **DOR** to 4 km may coarsen the product sufficiently to mask significant shear-producing features. The adaptable parameter **NFL**, by filtering the data further, reduces peak shear values. It will also “smear” data into empty grid points that are neighboring grid points with shear. Note: a value of 1 for NFL does no filtering and a value of 25 does the most smoothing.

Because the overall domain remains fixed at 232 x 232 km, increasing the resolution from 4 km to 0.5 km increases the number of bins in the Cartesian grid by a factor of 64, and thus increases the amount of processing that must be performed by the RPG. Changing the **NFL** from 1 to 25 further significantly increases the processing load.

```
                                COMBINED SHEAR                     PAGE  1 OF  1
COMMAND: AD,*****,M,*****,CO,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM         DOR    MSR    NFL    NSV    NTH    THCS    ELEV     CI

-----------------------------------------------------------------------
CURRENT      1.0    660     9      3     .75    2.0        1        2
-----------------------------------------------------------------------
MIN          0.5    650     1      3     .01    0.0        1        1
MAX          4.0    660    25      5     .99    5.0       20        5

Abbr  Description                Units  Abbr  Description               Units
DOR - Grid Res(.5, 1, 2, or 4)    Km    THCS- Threshold Combined Shear
MSR - Max# Sample Vols per Radial  -          considered Non-zero      E10-3/S
NFL - #Pts in Filter(1, 9, or 25)  -    ELEV- Elev Cut# for running Alg.   -
NSV - #Vols in Vel Avg(3 OR 5)     -    CI  - Com. Shear Cont. Interval E10-3/S
NTH - Ratio of #Good to #Possible
      Shear Values per Grid Box    -
```

Figure 6.4-1

6.5 Hail - Delegated URC Authority

The OSF authorizes the URC to modify the POSH setting for the Hail Detection Algorithm within the restrictions define below.

6.5.1 Delegated Authority Restrictions

The default value for POSH is 50 %. The URC may lower this value to 30% when summertime atmospheric conditions are present. Summertime atmospheric conditions are characterized by a relatively high melting level (> 13 kft) and low vertical shear (< 30 kts at 500 mb). When the summertime environment is no longer present the POSH OFFSET should be reset to 50%.

6.5.2 Supplemental Information

The Hail Detection Algorithm provides for each storm cell the following three estimates:

* the Probability of Hail (POH) of any size,

* the Probability of Severe Hail (POSH) (or hail $\geq$ 3/4” in diameter), and

* the Maximum Expected Hail Size (MEHS).

Based on drop-size/hailstone distribution and empirical studies, the algorithm assumes that large reflectivity values observed aloft (above the freezing level (0^oC)) are most likely hail. The algorithmís inputs are environmental data and storm cells components’ maximum reflectivity and height above ground level (AGL). The environmental data is the height (MSL) of the 0^oC and -20^oC environmental temperatures (see section 6.2.2 Hail Temperatures/ Default Storm Motion - URC LOCA). Hail estimates are only provided for storm cells identified within the Maximum Hail Processing Range; beyond that range hail estimates are labeled ‘UNKNOWN’.

To determine the POH of any size for each storm cell, the height of the highest component with a maximum reflectivity value of at least Thresh Min Reflectivity POH, which is above the freezing level, is used in an empirical relationship. The higher the component is above the freezing level, the greater the POH. The increasing heights correlate to probabilities through the POH Height Difference parameters.

To determine the POSH and MEHS for each storm cell, the algorithm uses a relationship between reflectivity and the Hailfall Kinetic Energy (HKE), the flux of kinetic energy of hailstones. HKE is calculated from components with maximum reflectivity values (of at least Thr HKE Ref Wgt Lower Lim) above the freezing level using an equation with the HKE Coefficients. The computation is weighted toward those components with a maximum reflectivity of at least Thr HKE Ref Wgt Upper Lim. A vertical integration of the HKE is done for all components within a storm cell (which meet the relative height and reflectivity criteria), resulting in a parameter called the Severe Hail Index (SHI). The integration is weighted toward those components above the height of the -20^{o}C environmental temperature. The greater the collective depth of components in a storm cell with large HKE values and the higher those components are above the freezing level, the larger a storm cell's SHI value. The MEHS for each storm cell is computed using SHI in an empirical formula with the SHI Hail Size Coefficient and SHI Hail Size Exponent.   The POSH is calculated from SHI, the POSH Coefficient, the POSH Offset, and a warning threshold which is a function of the height of the freezing level, the Warn Thresh Select Model Coefficient, and the Warn Thresh Select Model Offset*.

*NOTE: The Warn Thresh Select Model Offset is a site specific parameter based on the RDA height msl.

For the RCM product, the POSH is converted to a Hail Index using the Threshold (RCM Probable Hail) and Threshold (RCM Positive Hail) parameters.

6.5.3 Additional Reference Material

For additional information refer to the following paper:

Evaluation of the Hail Detection Algorithm for High-Elevation WSR-88D Sites, A. Witt, 1998 (http://www.osf.noaa.gov/ops/9032.htm)

```
                                  HAIL DETECTION                      PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HA,
FEEDBACK:                                                              OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                                 RANGE          VALUE         UNITS
THR HKE REF WGT LOWER LIM                  20 - 60          40           DBZ
THR HKE REF WGT UPPER LIM                  30 - 70          50           DBZ
THRESH MIN REFLECTIVITY POH                30 - 60          45           DBZ
HKE COEFFICIENT # 1             0.0000000001 - 1.0     0.000500000       -
HKE COEFFICIENT # 2                    0.005 - 0.5     0.084             -
HKE COEFFICIENT # 3                      1.0 - 100.0    10.0             -
POSH COEFFICIENT                         1.0 - 100.0    29.0             -
POSH OFFSET                                1 - 100        50             %
MAXIMUM HAIL PROCESSING RANGE            200 - 460       230             KM
SHI HAIL SIZE COEFFICIENT               0.01 - 1.0      0.10             -
SHI HAIL SIZE EXPONENT                   0.1 - 1.0       0.5             -
WARN THRESH SELECT MODEL COEFFICIENT  0.0 - 500.0       57.5           100 J/M**2/S
WARN THRESH SELECT MODEL OFFSET    -500.0 - 500.0     -121.0           10**5 J/M/S
```

```
                                  HAIL DETECTION                      PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HA,
FEEDBACK:                                                              OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                                 RANGE          VALUE         UNITS
POH HEIGHT DIFFERENCE #1                 0.0 - 20.0      1.625           KM
           DIFFERENCE #2                 0.0 - 20.0      1.875           KM
           DIFFERENCE #3                 0.0 - 20.0      2.125           KM
           DIFFERENCE #4                 0.0 - 20.0      2.375           KM
           DIFFERENCE #5                 0.0 - 20.0      2.625           KM
           DIFFERENCE #6                 0.0 - 20.0      2.925           KM
           DIFFERENCE #7                 0.0 - 20.0      3.300           KM
           DIFFERENCE #8                 0.0 - 20.0      3.750           KM
           DIFFERENCE #9                 0.0 - 20.0      4.500           KM
           DIFFERENCE #10                0.0 - 20.0      5.500           KM
THRESH (RCM PROBABLE HAIL)                 0 - 100          30           %
THRESH (RCM POSITIVE HAIL)                 0 - 100          50           %
```

6.6 Hydrometeorological Algorithms

The Hydrometeorological Algorithms menu is used to select one of the four Precipitation Processing Subsystem (PPS) menus.

```
                         HYDROMETEOROLOGICAL ALGORITHMS            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,HY,
FEEDBACK:                                                           OPER A/

Select From Menu Items.

Algorithm Options:

(AC)cumulation Precipitation Algorithm
(AD)justment Precipitation Algorithm
(P)reprocessing Precipitation Algorithm
(R)ate Precipitation Algorithm
```

Figure 6.6-1

6.6.1 Accumulation Precipitation

The following menu lists the adaptable parameters for the Accumulation Precipitation algorithm. This algorithm uses rainfall rates for the current and previous volume scans to compute an accumulation over the time between the scans. Additionally, hourly accumulations are computed and a check for any missing periods is made.

```
                      ACCUMULATION PRECIPITATION ALGORITHM         PAGE  1 OF  1
COMMAND: AD,*****,M,*****,HY,AC,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM         TIMRS    MXTIN    MNTIP    THRLI    ENGAG    MXPAC    MXHAC

-----------------------------------------------------------------------
CURRENT       60       30       54       400       0       400      800
-----------------------------------------------------------------------
MIN           45       15        0        50       0        50       50
MAX           60       60       60       800      59       400     1600

Abbr    Description                 Units  Abbr    Description              Units
TIMRS - Elapsed Time to Restart     MIN    MXHAC - Max Hrly Accum. Allowed  MM
MXTIN - Max Time (Interpolation)    MIN
MNTIP - Min Time (In Hrly Period)   MIN
THRLI - Thresh (Hrly Outlier)       MM
ENGAG - End Time (Gage Accum)       MIN
MXPAC - Max Period Accum. Allowed   MM
```

Figure 6.6-2

6.6.2 Adjustment Precipitation

The Adjustment Precipitation algorithm uses rain gage reports to adjust the radar estimates. A radar estimate is assigned to each gage amount and the gage-radar pairs are used to compute a multiplicative bias. The bias is then applied to the WSR-88D rainfall estimates out to 124 nm.

```
                     ADJUSTMENT PRECIPITATION ALGORITHM            PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,AD,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM         TBIES    NSETS    RESBI    REMSQ    MXMSQ    THDIF

--------------------------------------------------------------
CURRENT      50         6       1.0      0.5      0.8      15
--------------------------------------------------------------
MIN          50         2       0.5      0.1      0.5       5
MAX          59        30       2.0      0.8      1.0      60

Abbr    Description                  Units
TBIES - Time (Bias Estimation)       MIN
NSETS - Thresh (Number of Sets)
RESBI - Reset (Bias)
REMSQ - Reset (Mean Square Error)
MXMSQ - Max (Mean Square Error)
THDIF - Thresh (Time Difference)     MIN
```

Figure 6.6-3

```
                     ADJUSTMENT PRECIPITATION ALGORITHM            PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,AD,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM         MXPRO    SYNOI    VADJF    GADSC    MXGAC    THGAC

--------------------------------------------------------------
CURRENT      12.0     0.05      0.5      2.0      400      0.6
--------------------------------------------------------------
MIN           6.0     0.01      0.0      0.5       25      0.1
MAX          48.0     0.50     10.0     10.0     1600     25.4

Abbr    Description                  Units
MXPRO - Time (Reset BIAS)            Hours
SYNOI - System Noise
VADJF - Variance (Adj. Factor)
GADSC - Thresh (Gage Discard)
MXGAC - Max Gage Accum. Allowed      MM
THGAC - Thresh (Gage Accum.)         MM
```

Figure 6.6-4

6.6.3 Preprocessing Precipitation

During the PPS Preprocessing, reflectivity data from the lowest four elevation angles are assembled into a ‘hybrid scan’ of reflectivity data. At near ranges, progressively higher elevations are used to ensure the reflectivity data is not contaminated with residual ground clutter. At farther ranges (beyond about 26 nautical miles), reflectivity data from either of the lowest two tilts may be used in the “hybrid scan”, depending on decisions made by the “bi-scan optimization” process. This process combines a Tilt Test to reduce contamination from anomalous propagation and a Bi-scan Maximization to ensure the highest reflectivity value from the two tilts is used in the precipitation estimate.

Depending on the height of freezing level, the Bi-scan Maximization may erroneously select unrepresentative reflectivity values from the ‘bright band’ at the second tilt. This will lead to increased areas of precipitation overestimates due to the ‘bright band’. To allow each radar site to mitigate the effect of the ‘bright band’, the URC has been designated the LOCA for the adaptable parameter that controls the minimum range where the Bi-scan Maximization is applied **- MNRBI.** Using the default values for **MNRBI** (180 kilometers) and **MXRBI** (230 kilometers), the Bi-scan Maximization will normally be performed at a range that is not contaminated by the ‘bright band’, however if a site determines that second tilt ‘bright band’ reflectivities are contaminating the precipitation estimates, they should increase the value of **MNRBI**. If a site believes that the most representative reflectivity values are at the second tilt at a nearer range, **MNRBI** should be decreased to include the region where they want the Bi-scan Maximization to be performed.

```
                     PREPROCESSING PRECIPITATION ALGORITHM        PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,P,
FEEDBACK:                                                          OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MNRFL    MXRFL    RFTLT    IRTLT    ORTLT    MNRBI    MXRBI

-----------------------------------------------------------------------
CURRENT     18.0     70.0      1.0      40       150      180      230
-----------------------------------------------------------------------
MIN        -30.0     50.0      0.0       0        40        0        0
MAX         30.0     70.0     20.0     150       230      230      230

Abbr    Description              Units  Abbr    Description          Units
MNRFL - Min Thresh (Refl.)       dBZ    MNRBI - Min Range (BI-Scan)  KM
MXRFL - Max Thresh (Refl.)       dBZ    MXRBI - Max Range (BI-Scan)  KM
RFTLT - Refl. (Tilt Test)        dBZ
IRTLT - Inner Range (Tilt Test)  KM
ORTLT - Outer Range (Tilt Test)  KM
```

Figure 6.6-5

The PPS Tilt Test was designed to reduce clutter and anomalous propagation contamination in precipitation estimates by ignoring the lowest tilt reflectivity data when the Tilt Test considers the data are contaminated. The adaptable parameter MXPCT (OSF LOCA) defines the maximum threshold decrease in the area of reflectivity data between the first and second tilts, which indicates the presence of widespread anomalous propagation. The default value for MXPCT (75%) should generate the most representative precipitation estimates at most sites, particularly if clutter filtering is properly applied. However, field experience and OSF and OH investigations have shown that the Tilt Test may occasionally misinterpret actual rainfall events as anomalous propagation (thereby reducing the area and quantity of radar rainfall estimates) and, at times, the Tilt Test may include excessive areas of anomalous propagation in the precipitation estimates. If a site notes significant problems that they believe to be caused by the Tilt Test, it may request an Urgent Change to an OSF-Controlled Adaptation Value as explained in section 1.4.1 Highlighting URC and Agency LOCA Parameters.

```
                     PREPROCESSING PRECIPITATION ALGORITHM         PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,P,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MNECH     MNRAA     MXPCT     MNDBZ     MXDBZ

-----------------------------------------------------------------------
CURRENT      600      10.0       75        0.0     70.0
-----------------------------------------------------------------------
MIN          100       0.0        0      -32.0     50.0
MAX         3000      20.0      100       20.0     90.0

Abbr    Description               Units  Abbr    Description          Units
MNECH - Min Area (Echo)           KM**2
MNRAA - Min Refl. (Area Avgd)     dBZ
MXPCT - Max Area (% Reduction)    %
MNDBZ - Min dBZ Processed         dBZ
MXDBZ - Max dBZ Processed         dBZ
```

Figure 6.6-6

6.6.4 Rate Precipitation

The adaptable parameter **MXPRA** defines the maximum instantaneous precipitation rate (in mm/hr) that the PPS uses to estimate rainfall. At the default WSR-88D Z-R relationship ($Z=300\times R^{1.4}$), the default value of MXPRA (103.8 mm/hr) is equivalent to a reflectivity value of 53 dBZ. MXPRA can be used to mitigate the overestimation of precipitation caused by the high reflectivities associated with hail. If a site notes small regions of significant precipitation overestimation or underestimation that they believe are caused by an improper value for MXPRA, it may request an Urgent Change to this OSF-Controlled adaptation parameter value (see section1.5.1 Urgent Changes to OSF Controlled Adaptation Data Values).

Research, at several facilities including the OSF and the NWS Office of Hydrology, continues into determining the proper values for **MXPRA.** Establishing the proper value is complicated because there is no clearly defined value which separates rain from hail, because hail and rain frequently occur in the same radar bin, and because climatological maximum rainfall rates can be highly variable. The OSF recommends that the value for **MXPRA** be set within the range defined in the following Table 6.6 - 1:

Table 6.6 - 1: Rain Fall Rate vs: Equivalent Reflectivity

Rainfall Rate	Equivalent Reflectivity ($Z=300\times R^{1.4}$)
63.4 mm/hr (2.5 in/hr)	50 dBZ
74.7 mm/hr (2.9 in/hr)	51 dBZ
88.1 mm/hr (3.5 in/hr)	52 dBZ
103.8 mm/hr (4.1 in/hr)	53 dBZ
122.4 mm/hr (4.8 in/hr)	54 dBZ
144.3 mm/hr (5.7 in/hr)	55 dBZ

Generally, the value of MXPRA should be higher in a deep moist airmass than a dry shallow airmass. The highest values for MXPRA should be used in southern latitudes in the summer, and the lowest values should be used in northern latitudes in the spring. Changing the value of MXPRA within these limits will affect only small areas of rainfall in the cores of thunderstorms, however the value of MXPRA can significantly affect the rainfall estimates in those areas. Since the value of MXPRA is used as an upper limit by the PPS, no reflectivity values less than MXPRA will be affected.

It is important to note that prior to Build 9.0, the MXRFL (Maximum Reflectivity) and MXDBZ (Maximum dBZ) adaptable parameters in the PPS Preprocessing algorithm controlled the “hail cap”, i.e., the maximum reflectivity that the PPS will allow to be converted to rainfall. Now the MXPRA parameter (in units of rainrate, i.e., mm/hr) exclusively controls this hail cap.

```
                          RATE PRECIPITATION ALGORITHM             PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,R,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MXSPD    MXTDF    MNART    PTIM1    PTIM2    MXRCH

---------------------------------------------------------------
CURRENT     25       15.0      200     24.0     13.2     200
---------------------------------------------------------------
MIN         10       10.0       50      0.1      0.1      20
MAX         40       30.0     1000     99.9     99.9     700

Abbr    Description                   Units
MXSPD - Max Speed (Storm)             M/S
MXTDF - Thresh (Max Time Dif)         MIN
MNART - Min Area (Time Contin.)       KM**2
PTIM1 - Param (Time Contin. #1)       1/HR
PTIM2 - Param (Time Contin. #2)       1/HR
MXRCH - Max Rate (Echo Area Chng)     KM**2/HR
```

Figure 6.6-7

```
                          RATE PRECIPITATION ALGORITHM             PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,R,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        RNCUT    COER1    COER2    COER3    MNPRA    MXPRA

---------------------------------------------------------------
CURRENT     230      0.0       1.0     0.0       0.0      103.8
---------------------------------------------------------------
MIN           0      0.0       1.0     0.0       0.0       50.0
MAX         230      3.0      10.0     1.0      10.0     1600.0

Abbr    Description                 Units
RNCUT - Range (Cut-off)             KM
COER1 - Coef. (Range Effect #1)     dBR
COER2 - Coef. (Range Effect #2)
COER3 - Coef. (Range Effect #3)     dBR
MNPRA - Min Precip Rate Processed   MM/HR
MXPRA - Max Precip Rate Allowed     MM/HR
```

Figure 6.6-8

6.7 Layer Reflectivity/AP Removal

Without the proper application of clutter suppression, areas of AP-induced ground clutter return can appear as areas of significant precipitation. The Layer Reflectivity/AP Removal algorithm attempts to recognize areas of high reflectivity data caused by ground return due to anomalous propagation of the radar beam. The algorithm then removes the high reflectivity gates from consideration prior to building a low-layer (surface to 24 kft) layer composite reflectivity (APR) product. This product is used to support the FAA national aerospace weather monitoring program.

The following menu defines the adaptable parameters for the Layer Reflectivity/AP Removal only and does not affect the other layer composite reflectivity products.

```
                     LAYER REFLECTIVITY/AP REMOVAL                 PAGE  1 OF  2
COMMAND: AD,*****,M,*****,LA,
FEEDBACK:                                                           OPER A/

(M)ODIFY    (E)ND    (C)ANCEL

DESCRIPTION                               RANGE             VALUES     UNITS
--------------------------------------------------------------------------------
MINIMUM CLUTTER REFLECTIVITY              5. - 20.            10.0       DBZ
OMIT ALL ALTITUDE                          0 - 5                 1       KM
ACCEPT IF ALTITUDE                         0 - 10                3       KM
OMIT ALL DISTANCE(OUTER)                   0 - 100              45       KM
ACCEPT IF DISTANCE(OUTER)                  0 - 300             103       KM
REJECT IF DISTANCE(OUTER)                  0 - 300             230       KM
ACCEPT IF MAXIMUM ELEVATION               .0 - 5.0             0.5       DEG
REJECT IF MAXIMUM ELEVATION               .0 - 15.0            5.0       DEG
REJECT IF MINIMUM VELOCITY                .0 - 5.0             1.0       M/S
REJECT IF MINIMUM SPECTRUM WIDTH          .0 - 5.0             0.5       M/S
ACCEPT IF MINIMUM VELOCITY                .0 - 5.0             1.0       M/S
ACCEPT IF MINIMUM SPECTRUM WIDTH          .0 - 5.0             0.5       M/S
```

Figure 6.7-1

```
                     LAYER REFLECTIVITY/AP REMOVAL                PAGE  2 OF  2
COMMAND: AD,*****,M,*****,LA,
FEEDBACK:                                                          OPER A/

(M)ODIFY    (E)ND    (C)ANCEL

DESCRIPTION                             RANGE            VALUES     UNITS
--------------------------------------------------------------------------------
CLUTTER BLOOM/DILATION(CBD) PHASE       YES, NO            YES        -
  CBD MAXIMUM # RANGE BINS               0 - 20              4      BINS
  CBD MAXIMUM REFLECTIVITY              0. - 30.          10.0      DBZ
MEDIAN AVERAGING(MA) PHASE              YES, NO            YES        -
  MA MAXIMUM RANGE BIN DIFFERENCE       0 - 5                1      BINS
  MA MAXIMUM CROSS RANGE                0 - 10               2      KM
  MA MEDIAN FILTER PERCENT GOOD        0. - 100.            50       %
```

Figure 6.7-2

6.8 Mesocyclone - Delegated URC Authority

The OSF has authorized field personnel to change the TPV adaptable parameter in the Mesocyclone Algorithm.

6.8.1 Delegated Authority Restrictions

The default value of TPV is set at 10. Sites may change the value of TPV from 10 to lower values, but not lower than 6.

6.8.2 Supplemental Information

When ***NON-TRADITIONAL*** supercell mesocyclones are forecast or observed, UCP operators should consider reducing the Mesocyclone Algorithm adaptable parameter TPV. (TPV defines the minimum number of pattern vectors contained in a 2D feature.) At smaller values of TPV, the Mesocyclone Algorithm should produce more detections on smaller features. However, this change may also generate more false alarms. If the change has a detrimental effect on the mesocyclone algorithm's performance, return the adaptable parameter setting to its original value of 10.

6.8.3 Additional Reference Material

For additional information refer to the following papers:

A Study of Mini Supercells Observed by WSR-88D Radars, R. L. Lee, et al, 1995, and

Improvement of the Mesocylone Algorithm, R. L. Lee, 1996

.

```
                                MESOCYCLONE                      PAGE  1 OF  2
COMMAND: AD,*****,M,*****,M,
FEEDBACK:                                                         OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM       TFR   TRF    TFH     THM   THS    TLM   TLS   TMR   TMA   TRM

--------------------------------------------------------------------------------
CURRENT    4.0   1.6    8.0   540.0  14.4  180.0   7.2   2.0   1.9   0.5
--------------------------------------------------------------------------------
MIN        0.1   0.1    4.0   180.0   7.2   90.0   3.6   0.1   0.5   0.1
MAX       10.1  10.1   10.1  1080.0  28.8  540.0  14.4  10.0  10.0  10.0

Abbr Description              UNITS   Abbr Description            UNITS
TFR - Th(Far Max Ratio)               TLM - Th(Low Momentum)      Km2/Hr
TRF - TH(Far Min Ratio)               TLS - Th(Low Shear)          1/Hr
TFH - Th(Feature Height)        Km    TMR - Th(Max Ratio)
THM - Th(High Momentum)       Km2/Hr  TMA - Th(Meso Azimuth)       deg
THS - Th(High Shear)           1/Hr   TRM - Th(Min Ratio)
```

Figure 6.8-1

```
                                MESOCYCLONE                      PAGE  2 OF  2
COMMAND: AD,*****,M,*****,M,
FEEDBACK:                                                         OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM       TPV   TRD    TRA     MXF   MXM

--------------------------------------------------------------------------------
CURRENT     10  0.75  140.0     650    20
--------------------------------------------------------------------------------
MIN          1  0.25    0.0       1     1
MAX         20  5.00  230.0     650    20

Abbr Description              UNITS
TPV - Th(Pattern Vector)
TRD - TH(Radial Distance)       Km
TRA - Th(Range)                 Km
MXF - Max # Features
MXM - Max # Meso
```

Figure 6.8-2

6.9 Precipitation Detection

The Precipitation Detection Function (PDF) is designed to automatically determine if precipitation is occurring within 124 nm of the radar. The PDF examines reflectivity returns from the four lowest elevation angles, and compares them to the Precipitation Rate Threshold and an Area Threshold, which is the sum of the Precipitation Area Threshold and the Nominal Clutter Area Threshold. One of the following three Precipitation Categories is assigned each volume scan depending on which combination of thresholds are met or exceeded:

Category 0 - No precipitation detected.

Category 1 - Significant precipitation detected.

Category 2 - Light precipitation detected.

When Precipitation Category 1 has not been detected during the past hour, any VCP can be selected. When the assigned Precipitation Category is 1, the radar can only be operated in a Precipitation Mode (VCP 11 or 21).

When the assigned Precipitation Category is 1 or 2, the PPS computes rainfall accumulations and rain gage data is requested from the Gage Data Support System (GDSS). When the assigned Precipitation Category is 0, “null’ (zero-valued) rainfall products are generated and no gage data is requested from the GDSS.

6.9.1 Nominal Clutter Area - URC LOCA

Each line of the PDF menu is defined by a Tilt Domain (elevation angle range), a Precipitation Rate Threshold, the Nominal Clutter Area and Precipitation Area Thresholds, and the resulting Precipitation Category.

```
                            PRECIPITATION DETECTION                PAGE  1 OF  1
COMMAND: AD,*****,M,*****,P,
FEEDBACK:                                                           OPER A/

      (M)odify, {LINE#}   (E)nd     (C)ancel   (D)elete, {LINE#}

                       Precip     Nominal     Precip
                        Rate      Clutter      Area
          Tilt         Thresh      Area       Thresh       Precip
 N       Domain        (dBR)      (Km2)       (Km2)         Cat.
-------------------------------------------------------------------
             -
-------------------------------------------------------------------
 1       0.0    2.0     -2.0         80          20          2
 2       0.0    4.0      4.0        150          10          1
 3       2.0    4.0     -2.0         80          20          2
```

Figure 6.9-1

The Nominal Clutter Area (NCA) is the ***only*** adaptable parameter on the Precipitation Detection screen that may be changed under URC level of change authority. All others are under OSF level of change authority. The NCA allows the operator a way to account for residual clutter. By setting the NCA for both categories 1 and 2 equal to or slightly larger than the area of residual clutter, which is typically observed on days with no rainfall-producing echoes or anomalous propagation, you will prevent the radar from going into Precipitation Mode due to the presence of non-meteorological echoes. The NCA should be regularly monitored and set so that Precipitation Categories 1 and 2 are assigned by the PDF when real precipitation is occurring anywhere within range of the radar. In order to correctly set the NCA, the detected area of reflectivity returns can be checked on the Precipitation Status screen (ST,PRE).

The NCA value ***only*** affects the minimum areal threshold for assigning Precipitation Categories. If not correctly set, the NCA may allow for the accumulation of non-precipitation returns, but has ***no*** impact on the quality of other radar data. Thus, every effort should be made to filter normal and abnormal ground clutter at the RDA.

The PDF computes the areal coverage of return from all the reflectivities above the Rate Threshold values. The PDF does not discern between a ground return and a real precipitation target. In events where the PDF assigns a precipitation category incorrectly due to ground returns, the UCP operator should first attempt to reduce the ground returns using clutter suppression, and then account for any residual clutter with the NCA Threshold. The NCA is only a threshold value, and has no affect on the base data.

The NCA should ***NOT*** generally be used to prevent the radar from switching into Precipitation Mode A due to the presence of anomalous propagation echoes. To prevent the radar from switching into Mode A when transient anomalous propagation echoes are the only echoes present, it is recommended that you judiciously use operator-defined clutter suppression regions (Section 3.4.5 Supplemental Information - Operator-Defined Clutter Suppression Regions) during the time when the anomalous propagation conditions are occurring. This will improve the quality of the base data products and consequently the derived products as well. Increasing the NCA in anomalous propagation situations will not improve the quality of the base data since the anomalous propagation echoes will still remain in the products.

It is especially important to note that if operator-defined clutter suppression regions cannot properly remove all of the anomalous propagation contamination and therefore the decision is made to increase the NCA to prevent the radar from switching into Precipitation Mode A, then you should only increase the value of NCA for Precipitation Category 1 (line 2 in the table in Fig. 6.8-1). It is Precipitation Category 1 in the Precipitation Detection Function which controls what mode the radar operates in. If and when the NCA is increased to prevent the radar from switching into Precipitation Mode A because of the existence of anomalous propagation, the NCA must be promptly returned to the proper smaller value characteristic of residual clutter to permit the radar to operate properly and switch into Precipitation Mode when real rainfall begins.

You should never increase the values of NCA for the “light precipitation” Category 2 (lines 1 and 3 in Fig. 6.8-1) since Precipitation Category 2 controls if and when the precipitation algorithms run. The values of NCA for Category 2 should always remain at values which are slightly larger than the area of residual clutter on days with no rain- producing echoes.

In the event of anomalous propagation with NCA for Category 2 set to proper low values, the precipitation algorithms will execute as expected and automatically remove the negative effects of anomalous propagation on the precipitation estimates through quality control logic internal to the algorithms. The danger in indiscriminately increasing the NCA for Precipitation Category 2 is that the precipitation algorithms may not execute when in fact it is raining. This may occur, for example, when a rain event is developing and the radar operator forgets that the Category 2 values had been increased. This will result in the unrecoverable loss of rainfall accumulation for that period. Note that this would be a more serious effect than had that person used operator-defined clutter suppression regions to remove anomalous propagation and forgotten to delete them after the AP conditions abated since only those areas with zero radial velocity would be improperly underestimated. ***It is important that the rainfall algorithms execute even when the lightest rain is occurring in order to preserve water volume for the hydrologic models.***

6.9.2 Supplemental Information - Mode B and Very Light Precipitation

At times, precipitation accumulations may be desired while the radar is operating in a Clear Air Mode VCP. This is appropriate for very light rain or snow events. In this case, it is permissible under URC guidelines, to raise the NCA threshold value for Category 1 precipitation, but leave it set relatively low for Category 2 precipitation. If this is done, the Precipitation Rate and Area thresholds will be exceeded for Category 2, but will not be exceeded for Category 1. Any VCP can be invoked, and precipitation products will accumulate rainfall estimates.

The Precipitation Status Screen (ST,PRE) provides the results from the Precipitation Detection Function for each volume scan. Types of data include the currently assigned precipitation category and the time left until the operator may select a Clear Air Mode VCP. Additionally, the detected area of reflectivity returns above the precipitation rate threshold can be used to correctly adjust the NCA.

6.10 Storm Cell Segments

This algorithm identifies radial sequences of reflectivity, or segments, as part of the processing to identify storm cells. These segments are runs of contiguous range bins with reflectivity values greater than or equal to a specified **Threshold (Reflectivity)** and have a combined length greater than a specified **Threshold (Segment Length)**. Also, a segment may contain up to a **Threshold (Dropout Count)** number of contiguous range bins which are within **Threshold (Dropout Ref Diff)** below the reflectivity threshold. The range of allowable values for these adaptable parameters are such that the parameters can be set low enough to identify and track snow showers.

The algorithm has seven **Reflectivity Thresholds** (and a minimum segment length threshold for each reflectivity threshold). The algorithm searches for segments within the **Threshold (Max Segment Range)**. As a processing limitation, there is a maximum number of segments per radial (for each reflectivity threshold) and per elevation scan, **Max # of Segments/Radial** and **Max # of Segments/Elev**, respectively.

For each segment, the following attributes are calculated and saved: maximum reflectivity, mass-weighted length, and mass-weighted length squared. The maximum reflectivity is a running average of the reflectivity values in **Reflectivity Avg Factor** bins. To calculate the mass-weighted length and the mass-weighted length squared, the **Mass Weighted Factor**, **Mass Multiplicative Factor**, and **Mass Coefficient Factor** are used.

```
                              STORM CELL SEGMENTS                  PAGE  1 OF  2
COMMAND: AD,*****,M,*****,SE,
FEEDBACK:                                                           OPER A/

(M)odify (E)nd (C)ancel

DESCRIPTION                             RANGE              VALUES    UNITS
-------------------------------------------------------------------------------
THRESH (REFLECTIVITY #1)                 0 - 80                60     DBZ
       (REFLECTIVITY #2)                 0 - 80                55     DBZ
       (REFLECTIVITY #3)                 0 - 80                50     DBZ
       (REFLECTIVITY #4)                 0 - 80                45     DBZ
       (REFLECTIVITY #5)                 0 - 80                40     DBZ
       (REFLECTIVITY #6)                 0 - 80                35     DBZ
       (REFLECTIVITY #7)                 0 - 80                30     DBZ
THRESH (SEGMENT LENGTH #1)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #2)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #3)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #4)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #5)             1.0 - 5.0              1.9     KM
```

Figure 6.10-1

```
                              STORM CELL SEGMENTS                  PAGE  2 OF  2
COMMAND: AD,*****,M,*****,SE,
FEEDBACK:                                                           OPER A/

(M)odify (E)nd (C)ancel

DESCRIPTION                             RANGE              VALUES    UNITS
-------------------------------------------------------------------------------
THRESH (SEGMENT LENGTH #6)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #7)             1.0 - 5.0              1.9     KM
THRESH (DROPOUT REF DIFF)                0 - 10                 5     DBZ
THRESH (DROPOUT COUNT)                   0 - 5                  2     -
NBR REFLECTIVITY LEVELS                  1 - 7                  7     -
THRESH (MAX SEGMENT RANGE)             230 - 460              460     KM
MAX # OF SEGMENTS/RADIAL                10 - 50                15     -
MAX # OF SEGMENTS/ELEV                4000 - 6000            6000     -
REFLECTIVITY AVG FACTOR                  1 - 5                  3     -
MASS WEIGHTED FACTOR               50000.0 - 60000.0      53000.0   HR/KG/KM**4
MASS MULTIPLICATIVE FACTOR           450.0 - 550.0          486.0     -
MASS COEFFICIENT FACTOR               1.20 - 1.50            1.37     -
```

Figure 6.10-2

6.11 Velocity Dealiasing

The adaptable parameters for the velocity dealiasing algorithm are adjusted using the following menus.

6.11.1 Short Pulse

These parameters are used when operating in VCPs 11, 21, and 32.

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  1 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM         NRLA   NRLB   NLB    NLF    NBF    TDU      TSSD

------------------------------------------------------------------------------
CURRENT      10      4     30     15      5   10.00    0.40
------------------------------------------------------------------------------
MIN           5      4      5     10      5    1.00    0.00
MAX          20     10     45     20     10   15.00    1.00

Abbr  Description               Units    Abbr   Description              Units
NRLA - Num Replace (Look Ahead)          TDU  - Threshold (Diff Unfold)   M/S
NRLB - Num Replace (Look Back)           TSSD - Thresh (Scale Std. Dev.)
NLB  - Number (Look Back)
NLF  - Number (Look Forward)
NBF  - Number (Radial)
```

Figure 6.11-1

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  2 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM         TCBR   TMM    NRPA   NRCA   TMBJ   TJR      TJA

------------------------------------------------------------------------------
CURRENT       5     30     10     30      75    0.75    0.60
------------------------------------------------------------------------------
MIN           1     10      5     15      10    0.50    0.50
MAX          10     50     20     50     100    1.00    1.00

Abbr  Description               Units    Abbr   Description              Units
TCBR - Thresh (Consec Reject)            TJR  - Thresh (Vel Jump Fact)
TMM  - Threshold (Max Missing)           TJA  - Thresh (Az Diff Fact)
NRPA - Num (Reunfold Prev Az)
NRCA - Num (Reunfold Curr Az)
TMBJ - Thresh (Max Bins Jump)
```

Figure 6.11-2

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  3 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER B/L  32

         (M)odify  (E)nd  (C)ancel

ITEM        TMCJ   TBLA   EST    USF    ARRV   TSDU

------------------------------------------------------------------------------
CURRENT       5     10    720      1       1    1.50
------------------------------------------------------------------------------
MIN           1      3      1      0       0    1.00
MAX          10     12    999      1       1    2.00

Abbr  Description               Units    Abbr   Description              Units
TMCJ - Thresh (Max Cont Az Jump)         TSDU - Thresh (Scale Diff Unfld)
TBLA - Thresh (Num Az Jump)
EST  - Thresh (Sounding Age)     MIN
USF  - Flag (Sounding)
ARRV - Flag (Report Reject Vel)
```

Figure 6.11-3

6.11.2 Long Pulse

These parameters are used when operating in VCP 31.

```
                      LONG PULSE VELOCITY DEALIASING               PAGE  1 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        NRLA   NRLB   NLB    NLF    NBF    TDU      TSSD

------------------------------------------------------------------------------
CURRENT      10      4     30     15      10    3.00     0.80
------------------------------------------------------------------------------
MIN           5      4      5     10       5    1.00     0.00
MAX          20     10     45     20      10   15.00     1.00

Abbr  Description               Units    Abbr   Description              Units
NRLA - Num Replace (Look Ahead)          TDU  - Threshold (Diff Unfold)   M/S
NRLB - Num Replace (Look Back)           TSSD - Thresh (Scale Std. Dev.)
NLB  - Number (Look Back)
NLF  - Number (Look Forward)
NBF  - Number (Radial)
```

Figure 6.11-4

6.11.3 Additional Reference Material

For additional information refer to the following paper:

Efficient Dealiasing of Doppler Velocities Using Local Environmental Constraints, Eilts and Smith, 1990.

```
                      LONG PULSE VELOCITY DEALIASING              PAGE  2 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                          OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM         TCBR   TMM    NRPA   NRCA   TMBJ   TJR      TJA

------------------------------------------------------------------------------
CURRENT         5     30     10     30      40    0.75    0.60
------------------------------------------------------------------------------
MIN             1     10      5     15      10    0.50    0.50
MAX            10     50     20     50     100    1.00    1.00

Abbr  Description               Units    Abbr   Description              Units
TCBR - Thresh (Consec Reject)            TJR  - Thresh (Vel Jump Fact)
TMM  - Threshold (Max Missing)           TJA  - Thresh (Az Diff Fact)
NRPA - Num (Reunfold Prev Az)
NRCA - Num (Reunfold Curr Az)
TMBJ - Thresh (Max Bins Jump)
```

Figure 6.11-5

```
                      LONG PULSE VELOCITY DEALIASING              PAGE  3 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                          OPER B/L  32

         (M)odify  (E)nd  (C)ancel

ITEM         TMCJ   TBLA   EST    USF    ARRV   TSDU

------------------------------------------------------------------------------
CURRENT         2     10    720      1       1    1.20
------------------------------------------------------------------------------
MIN             1      3      1      0       0    1.00
MAX            10     12    999      1       1    2.00

Abbr  Description               Units    Abbr   Description              Units
TMCJ - Thresh (Max Cont Az Jump)         TSDU - Thresh (Scale Diff Unfld)
TBLA - Thresh (Num Az Jump)
EST  - Thresh (Sounding Age)     MIN
USF  - Flag (Sounding)
ARRV - Flag (Report Reject Vel)
```

Figure 6.11-6

6.12 Severe Weather Probability (SWP)

This menu allows changing the SWP coefficient parameters and the box size for which SWP values are calculated.

```
                                      SWP                          PAGE  1 OF  1
COMMAND: AD,*****,M,*****,SW,
FEEDBACK:                                                           OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM        SBS    SW1      SW2      SW3      SW4      SW5      SW6

-----------------------------------------------------------------------
CURRENT      28    5.820   -0.576   -0.964    0.000    0.046    0.000
-----------------------------------------------------------------------
MIN          12  -99.999  -99.999  -99.999  -99.999  -99.999  -99.999
MAX         100   99.999   99.999   99.999   99.999   99.999   99.999

Definitions                Units          Definitions            Units
SBS - SWP Box Size            km          SW4 - SWP Coef 4           -
SW1 - SWP Coef 1               -          SW5 - SWP Coef 5           -
SW2 - SWP Coef 2               -          SW6 - SWP Coef 6           -
SW3 - SWP Coef 3               -
```

Figure 6.12-1

6.13 Storm Cell Tracking and Forecast

The Storm Cell Tracking and Storm Position Forecast algorithms, components of the Storm Cell Identification and Tracking (SCIT) algorithm suite, monitor and predict the movement of storm cells. Although the SCIT algorithm suite exhibits significant tracking and forecast skill, cell mergers/splits and rapid cell decay/growth may not be handled well.

The first step is matching storms found in the current volume scan to the storm cells from the previous volume scan in time and space. The second step is to forecast their movement.

The storm cells are matched as follows. Starting with the most intense cell (i.e. largest cell-based VIL value) in the current volume scan, the centroid position is compared to the projected centroid positions of cells from the previous volume scan. A cell's projected centroid position is its forecasted position for the current volume scan. The cell from the previous volume scan with a projected centroid located within a distance computed from the **Correlation Speed** which is closest to the current cell is correlated. When a cell is correlated, it is considered the same cell and assigned the same storm cell ID. Then, the next most intense cell in the current volume scan is compared to all uncorrelated cells in the previous volume scan, and so on, until all cells in the current volume scan are processed. Once a cell from the previous volume scan is correlated, it is not compared to any more cells in the current volume scan. If no projected centroid positions are within the adaptable range of a cell's centroid position, the cell remains uncorrelated and is assigned a new storm cell ID. If a time period of more than **Time (Maximum)** has passed between the current and past volume scans, then no matching is done, and all storms in the current volume scan are considered new. The centroid positions used are in a Cartesian coordinate system with the radar at the origin, and where the X-axis denotes east-west directions and the Y-axis denotes north-south directions.

The forecast of a storm cell's movement is based on the cell's movement over its lifetime, for up to the **Number of Past Volumes**, including the current volume scan. The first time a storm cell is detected it is labeled new. In this case, no prediction of movement is made, and the cell is assigned a vector average storm motion of all cells in the previous volume scan (or the default storm motion if no storm cells previously existed (see Section 6.2.2)). After the first volume scan a storm cell is detected, a forecast movement is computed based on a linear least squares extrapolation of its previous movement. Forecast positions are computed in time steps equal to the **Forecast Interval**. The number of forecast positions, or **Number of Intervals**, computed for a cell depends upon the scaled forecast error and the permissible error. The scaled forecast error is the accuracy of the previous volume scan's forecast (or forecast error) scaled by the ratio of the **Error Interval** over the time between volume scans. The permissible error is the **Allowable Error** scaled by the **Error Interval** over the length (in time) of the forecast (for this **Forecast Interval**). Basically, the poorer a forecast was for a cell for the past volume scan, the fewer the number of forecast positions. For display purposes only, if a storm cell's forecasted movement is less than the **Thresh (Minimum Speed)**, then no past and forecast positions are graphically displayed. In this case, the cell's movement is displayed as a centroid symbol with a concentric circle (at the current position).

```
                       STORM CELL TRACKING AND FORECAST            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,TR,
FEEDBACK:                                                           OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                             RANGE              VALUE    UNITS
--------------------------------------------------------------------------------
CORRELATION SPEED                    10.0 - 40.0           30.0     M/S
NUMBER OF PAST VOLUMES                  7 - 13               10     -
NUMBER OF INTERVALS                     1 - 4                 4     -
FORECAST INTERVAL                       5 - 30               15     MIN
ALLOWABLE ERROR                        10 - 60               20     KM
ERROR INTERVAL                          5 - 30               15     MIN
THRESH (MINIMUM SPEED)                0.0 - 10.0            2.5     M/S
TIME (MAXIMUM)                         10 - 60               20     MIN
```

Figure 6.13-1

6.14 Tornado Detection Algorithm (TDA) - Delegated URC Authority

The Tornado Detection Algorithm (TDA) is the Build 10 replacement for the Tornadic Vortex Signature (TVS) algorithm. The TDA is designed to search base velocity data to identify intense circulations which are producing or about to produce tornadoes. The output from this algorithm is used to build the TVS product. The circulations identified by the TDA are called TVSes (and ETVSes) as in the old TVS Algorithm.

The TDA adaptable parameters were determined from studies on a large, geographically diverse data set of tornadic events. These studies were conducted by persons from NWS forecast offices, the NSSL, and the OSF. During TDA's development, the algorithm's performance and the default parameters were considered optimized when the Critical Success Index (CSI) was highest. Using default adaptable parameter values, Mitchell et. al. (1998, Weather and Forecasting, in press) showed the TDA to have a POD = 46, an FAR = 39, and a CSI = 36. And comparison studies by Mitchell (28th Conference on Radar Meteorology, *A Performance Evaluation in Comparison of the NSSL Tornado Detection Algorithm and the WSR-88D Tornadic Vortex Signature Algorithm*, 1997) showed that the old TVS Algorithm with optimized adaptable parameters had a POD = 7, an FAR = 8, and a CSI = 7.

Until further field experience is gained, all the TDA adaptable parameters will remain under the OSF LOCA. However, since the operational approach differs from site to site and TDA algorithm performance characteristic vary in different weather regimes, the OSF authorizes the Unit Radar Committees (URCs) to change selected TDA adaptable parameters in accordance with the guidance and restrictions presented in the following paragraphs.

6.14.1 Delegated Authority Restrictions

Most adaptable parameters for the Tornado Detection Algorithm (TDA) are OSF-level of Change Authority, the URC may change the Minimum Reflectivity Threshold, the Maximum Pattern Vector Range, and Maximum Number of Elevated TVSs within the limits discussed below. In addition, there are four different TDA adaptable parameter sets which each URC may select from to best meet the needs of its members. They are: 1) a Default Set which optimizes overall algorithm performance, 2) a Minimized Set which makes the TDA mimic the performance of the old TVS algorithm, 3) a Squall Line Set that optimizes TDA for squall lines, and 4) a Tropical Cyclone Set that optimizes TDA for tropical cyclones. These sets of adaptable parameters are described below. The OSF plans to add and possibly modify parameter sets as needed.

6.14.1.1 Minimum Reflectivity Threshold

The URC may change the Minimum Reflectivity Threshold parameter to any value between 0 and 20 dBZ (0 dBZ = default), even though the UCP screen shows a range of -20 dBZ to 20 dBZ. This adaptable parameter prevents identification of one-dimensional pattern vectors and, hence, any TVSs (or ETVSs) from any velocity sample volumes that do not also have a corresponding reflectivity of at least the threshold value. Increasing the value will eliminate TVS identifications in low reflectivity regions and, at the same time, decrease the amount of processing for the algo rithm possibly helping to alleviate CPU loadshedding. Therefore, a URC may increase the value (above 0 dBZ) if there are irksome false alarm TVSs (or ETVSs) being identified in areas of low reflectivity which are clearly not tornadic storms. These false alarms may be found in shear regions such as sea breezes, gustfronts, and velocity dealiasing errors primarily close to the radar. Studies have shown that increasing the value (above 0 dBZ) will slightly decrease the TDA's overall performance. The Minimum Reflectivity Threshold value should not be set below 0 dBZ. Parameter studies have shown that the number of false alarms increases as the reflectivity threshold is lowered below 0 dBZ.

6.14.1.2 Maximum Pattern Vector Range

The URC may change the Maximum Pattern Vector Range parameter only to a value between 100 and 150 km (100 km = default), even though the UCP screen shows a range of Maximum Pattern Vector Range to be 0 - 230 km. One-dimensional pattern vectors and, hence, any TVSs (or ETVSs) can only be identified within this range. Decreasing this parameter to values less than 100 km limits the radar umbrella coverage for TVS detections. Increasing the parameter will extend the algorithm's processing range and processing load (or CPU at the RPG). The default value (of 100 km) was determined from a diverse set of cases. And, overall, when the range is extended, algorithm performance decreases due to beam broadening and increasing beam height. Also, at longer distances, there is a greater likelihood of range folding and dealiasing errors which decreases algorithm performance. However, in cases with very strong, tall tornadic storms, performance does not decrease when the range is extended. Therefore, a URC may increase the value up to 150 km to extend the TDA processing range.

6.14.1.3 Maximum # of Elevated TVSs

The maximum number of elevated TVS's represents the maximum number of ETVSs that the algorithm can process per volume scan. This parameter permits the detection of more or fewer elevated TVSs. Since statistical studies on ETVS were not complete at the time of Build 10 release, the default value of Maximum # of Elevated TVSs was set to zero. With a default value of 0, this parameter stops TDA from identifying ETVSs and the ETVS detections are not placed on the Combined Attribute Table. If users decide to generate ETVSs, with a value greater than 0, ETVSs will be placed in the Combined Attribute Table and NIDS users will receive ETVS information. If ETVSs are generated at the RPG, users will have to change an adaptable parameter on the PUP (Display ETVSs Yes or No?) from a default value of No to a value of Yes to display the ETVS detections on the PUP screen.

6.14.1.4 Adaptable Parameter Sets

The build 10 TDA uses 30 adaptable parameters to specify program memory limits, modify data processing thresholds, and establish criteria for detecting 2D (2-dimensional) and 3D vortex features. Three of these 30 adaptable parameters filter 3D vortices by depth and gate-to-gate velocity difference.

The LLDV value (TVS classification criterion) specifies the minimum gate-to-gate velocity difference allowed at the lowest elevation angle in a 3D vortex. The MLDV value (TVS classification criterion) specifies the minimum gate-to-gate velocity difference allowed anywhere within a 3D vortex. (The TDA requires the LLDV value **or** the MLDV value to be greater than a specified threshold to identify a TVS signature.)

The depth value specifies the minimum depth allowed for a 3D vortex to be identified as a TVS. By systematically adjusting the values of these three adaptable parameters, TDA performance was optimized for several convective data sets.

Scientists from the NSSL and the OSF analyzed 34 cases containing 2134 volume scans (approximately 194 hours of radar data) representing 168 tornadoes from many different areas of the United States.

The thirty-four cases were categorized by storm type (15 isolated supercell cases, 13 squall line cases, and six tropical storm cases). A composite data set was created by combining all the squall line and isolated supercell cases.

6.14.1.4.1 Default Adaptable Parameter Set

The set of adaptable parameters (LLDV, MLDV, and depth) which optimized algorithm performance on the composite data set are recommended for general use. The URC is authorized to make the following changes:

DEFAULT ADAPTABLE PARAMETER SET
Depth = 1.5 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 25 m/s
Minimum TVS Delta Velocity (MLDV) = 36 m/s.
These values of LLDV, MLDV, and Depth are to be used only in this combination.

6.14.1.4.2 Minimized Adaptable Parameter Set

With the default adaptable parameter values, the TDA will identify more TVS circulations than the old TVS Algorithm. Obviously, this will result in a major change in operational approach to using the new TDA versus the old TVS Algorithm. For the old TVS Algorithm, the algorithm rarely identified a TVS (i.e. low POD), but if a TVS was identified, then the circulation was likely tornadic or about to be (i.e. extremely low FAR). With the new TDA using the default values, it will not be uncommon during a severe weather event for TDA to identify multiple TVSs in one volume scan, and sometimes, more than one TVS associated with the same storm. The user should always use other information (e.g. knowledge of environment, reflectivity structure, etc.) to discriminate between those which are actually producing or about to produce a tornado. Forecasters who have been using the NSSL WDSS test platform for the last 2 years have been using the TDA algorithm and find its performance acceptable and much better than the old TVS algorithm, in spite of the increased number of detections.

However, it is recognized that the default set and/or this operational approach is not best for all users. Therefore, in addition to the default set, authority is given to the URC's to use a Minimized Adaptable Parameter Set. URCs may use the Minimized Set of adaptable parameters to make the TDA performance similar to the old TVS Algorithm. When the Minimized Set is used, the TDA will identify TVSs only rarely (i.e. low POD, FAR, and CSI). The Minimized Set is provided in case some sites want to make the new TDA Algorithm emulate the performance of the old TVS Algorithm. When selecting this mode of operation, the URC is authorized to make the following changes:

6.14.1.4.3 Squall Line Adaptable Parameter Set

The set of adaptable parameters (LLDV, MLDV, and depth) which optimized algorithm performance on the squall line data set are recommended for use in squall lines. The URC is authorized to make the following changes:

SQUALL LINE ADAPTABLE PARAMETER SET
Depth = 1.6 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 27 m/s
Minimum TVS Delta Velocity (MLDV) = 27 m/s
These values of LLDV, MLDV, and Depth are to be used only in this combination.

6.14.1.4.4 Tropical Cyclone Adaptable Parameter Set

The set of adaptable parameters (LLDV, MLDV, and depth) which optimized algorithm performance on the tropical cyclone data set are recommended for use in tropical cyclones. The URC is authorized to make the following changes:

TROPICAL CYCLONE ADAPTABLE PARAMETER SET
Depth = 2.0 km.
Minimum 3D Feature Low Level Delta Velocity (LLDV) = 14 m/s
Minimum TVS Delta Velocity (MLDV) = 44 m/s
These values of LLDV, MLDV, and Depth are to be used only in this combination.

NOTE

Ensure that the remaining adaptable parameters are set to the default values. Again, it is anticipated that more sets will be available as more studies are completed.

```
                                     TVS                            PAGE  1 OF  3
COMMAND: AD,*****,M,*****,TV,
FEEDBACK:                                                            OPER A/

      (M)odify  (E)nd  (C)ancel

DESCRIPTION                            RANGE                VALUES    UNITS
-------------------------------------------------------------------------------
MINIMUM REFLECTIVITY THRESHOLD       -20 - 20                  0     DBZ
VECTOR VELOCITY DIFFERENCE            10 - 75                 11     M/S
MAXIMUM PATTERN VECTOR RANGE           0 - 230               100     KM
MAXIMUM PATTERN VECTOR HEIGHT        0.0 - 15.0             10.0     KM
MAXIMUM # OF PATTERN VECTORS        1500 - 3000             2500     -
DIFFERENTIAL VELOCITY #1              10 - 75                 11     M/S
DIFFERENTIAL VELOCITY #2              15 - 80                 15     M/S
DIFFERENTIAL VELOCITY #3              20 - 85                 20     M/S
DIFFERENTIAL VELOCITY #4              25 - 90                 25     M/S
DIFFERENTIAL VELOCITY #5              30 - 95                 30     M/S
DIFFERENTIAL VELOCITY #6              35 - 100                35     M/S
MINIMUM # VECTORS/2D FEATURE           1 - 10                  3     -
```

Figure 6.14-5

```
                                     TVS                            PAGE  2 OF  3
COMMAND: AD,*****,M,*****,TV,
FEEDBACK:                                                            OPER A/

      (M)odify  (E)nd  (C)ancel

DESCRIPTION                            RANGE                VALUES    UNITS
-------------------------------------------------------------------------------
2D VECTOR RADIAL DISTANCE            0.0 - 3.0               0.5     KM
2D VECTOR AZIMUTHAL DISTANCE         0.0 - 4.0               1.5     DEG
2D FEATURE ASPECT RATIO              1.0 - 10.0              4.0     KM/KM
CIRCULATION RADIUS  #1               0.0 - 10.0              2.5     KM
CIRCULATION RADIUS  #2               0.0 - 10.0              4.0     KM
CIRCULATION RADIUS RANGE               1 - 230                80     KM
MAXIMUM # 2D FEATURES                600 - 800               600     -
MIN # 2D FEATURES/3D FEATURE           1 - 10                  3     -
MINIMUM 3D FEATURE DEPTH             0.0 - 5.0               1.5     KM
MIN 3D FEAT LOW-LVL DELTA VEL          0 - 100                25     M/S
MINIMUM TVS DELTA VELOCITY             0 - 100                36     M/S
MAXIMUM # 3D FEATURES                 30 - 50                 35     -
```

```
                                      TVS                            PAGE  3 OF  3
COMMAND: AD,*****,M,*****,TV,
FEEDBACK:                                                             OPER A/

      (M)odify  (E)nd  (C)ancel

DESCRIPTION                            RANGE              VALUES    UNITS
-------------------------------------------------------------------------------
MAXIMUM # OF TVSs                      15 - 25              15      -
MAXIMUM # OF ELEVATED TVSs             15 - 25               0      -
MINIMUM TVS BASE HEIGHT               0.0 - 10.0           0.6      KM
MINIMUM TVS BASE ELEVATION            0.0 - 10.0           1.0      DEG
AVERAGE DELTA VELOCITY HEIGHT         0.0 - 10.0           3.0      KM
MAXIMUM STORM ASSOCIATION DIST        0.0 - 20.0          20.0      KM
```

6.14.2 Supplemental Information

To support local TDA performance studies using Archive II playback via WATADS, a brief description of each TDA adaptable parameter is provided below.

MINIMUM REFLECTIVITY

The TDA only identifies Pattern Vectors from velocity data from radar bins that have corresponding reflectivity values which meet or exceed this threshold. Therefore, this parameter allows the operator to increase or decrease the number of algorithm detections within weak reflectivity regions. Changing this parameter will also greatly affect the amount of work (or CPU) that the algorithm does.

Increasing the threshold from 0 to +20 dBZ reduces the number of circulations detected, both real and false alarms; but also, increases the number of misses. At the same time, this change would decrease the amount of work the algorithm does. Decreasing the threshold from 0 to -20 dBZ greatly increases the number of false alarms and the amount of work performed by the algorithm.

The Minimum Reflectivity parameter is modifiable by the URC.

VECTOR VELOCITY DIFFERENCE

The minimum required gate-to-gate velocity difference required for Pattern Vectors. Lower threshold values require additional memory and computing time but result in the detection of weaker circulations (e.g. tornadoes along gust fronts, derechos). However, lower values may result in more false alarms. Conversely, increasing VECTOR VELOCITY DIFFERENCE may constrain the algorithm to only identify the stronger circulations, reducing detections and false alarms.

The Vector Velocity Difference parameter is not modifiable by the URC.

MAXIMUM PATTERN VECTOR RANGE

Maximum slant range at which Pattern Vectors are identified. It may be necessary to limit the detection of circulations beyond a certain range (100 km = default) from the radar due to lack in the algorithm's ability to identify long range, tornadic circulations. At long ranges, the algorithm may only detect mid-level rotation on a mesocyclone size scale. As a tornadic storm with an identified TVS moves beyond the Maximum Pattern Vector Range, the TVS detection will be lost. Using the default value of Maximum Pattern Vector Range, TDA will stop identifying storms that move beyond 100 km.

CPU loadshedding may result for large values of this parameter as more detections and their components are identified and processed. Of course, events beyond MAXIMUM PATTERN VECTOR RANGE will not be identified.

The Maximum Pattern Vector Range parameter is modifiable by the URC.

MAXIMUM PATTERN VECTOR HEIGHT

Maximum height at which Pattern Vectors are identified. If computing resources are limited then this value may be set lower. The range of detection decreases with a decrease in MAXIMUM PATTERN VECTOR HEIGHT (decrease probability of detection).

The Maximum Pattern Vector Height parameter is not modifiable by the URC.

MAX # OF PATTERN VECTORS

Maximum number of Pattern Vectors the algorithm will process per elevation scan. Too few Pattern Vectors may cause the algorithm to miss important circulations. In large, intense squall lines, a large number of Pattern Vectors may contribute to CPU loadshedding at the RPG.

The Maximum Number of Pattern Vectors parameter is not modifiable by the URC.

DIFFERENTIAL VELOCITY #1-#6

The six velocity difference thresholds used as criteria for building 2D Features.

1) Threshold values should increase from smallest to largest;

2) It is recommended that the difference between successive threshold values not exceed 5 m/s (e.g. 11, 15,20,25,30,35 m/s).

The use of multiple thresholds costs more in terms of computing and memory requirements. Increasing the value of the thresholds will make the algorithm less sensitive; i.e., it will not identify the weaker circulations. However, it is not known exactly how the algorithm would respond to changes in the thresholds.

The Differential Velocity #1 - #6 parameters are not modifiable by the URC.

MINIMUM # VECTORS / 2D FEATURE

Minimum number of Pattern Vectors required to declare a 2D Feature. The lower the threshold, the greater the chance for detecting smaller scale phenomena (e.g., tornadic vortices along a gust front, landspouts, etc.,). However, this also increases the chances of CPU loadshedding and can cause a greater number of false alarms.

Adjusting this parameter toward the upper limit (10 pattern vectors) will significantly reduce the likelihood of false alarms but will limit the algorithm to detecting only the larger scale circulations (e.g. supercell tornadoes).

The Minimum number of vectors per 2D feature parameter is not modifiable by the URC.

2D VECTOR RADIAL DISTANCE

Maximum radial distance allowed between two Pattern Vectors to be associated into the same 2D feature. This parameter constrains the construction of 2D Features to only those pattern vectors which are in close radial proximity. Increasing this threshold may increase the number of false alarms.

The 2D Vector Radial Distance parameter is not modifiable by the URC.

2D VECTOR AZIMUTHAL DISTANCE

Maximum azimuthal distance allowed for two Pattern Vectors to be associated into the same 2D feature. This parameter constrains the construction of 2D Features to only those pattern vectors which are in close proximity. Increasing this thresholds may also increase the number of false alarms and may contribute to CPU loadshedding.

The 2D Vector Aximuthal Distance parameter is not modifiable by the URC.

2D FEATURE ASPECT RATIO

Maximum allowable aspect ratio (delta Range (Slant)/ delta Azimuth) for a 2D Feature. This parameter discards long thin regions of shear such as some velocity dealiasing errors oriented along an azimuth. More appropriate values (e.g. 2) may be deemed necessary for identifying bonafide circulations. Larger values (greater than 4) may result in a high false alarm rate due to gust fronts oriented along the beam being identified.

The 2D Feature Aspect Ratio parameter is not modifiable by the URC.

CIRCULATION RADIUS 1

The maximum horizontal radius used for searching for 2D Features on adjacent or the same elevation scans in building a 3D feature. This radius is used when the Range(Slant) of an assigned 2D feature is less than or equal to Threshold Circulation Radius Range. (See description for CIRCULATION RADIUS RANGE).

Increasing this parameter will allow highly tilted circulations to be identified. The distance between two consecutive 2D features is a function of both vortex tilt and vortex translation between elevation angles. Also, the distance between two consecutive 2D circulations may become quite large at larger ranges due to spreading of the radar beam, and artificial shifting of azimuthal shear by improper velocity dealiasing.

Small values may limit the algorithm's ability to fully construct 3D features. Large values may result in a higher false alarm rate by associating unrelated and/or false circulation signatures.

The Circulation Radius 1 parameter is not modifiable by the URC.

CIRCULATION RADIUS 2

The maximum horizontal radius used for searching for 2D features on adjacent or the same elevation scans in building a 3D feature. This radius is used when the Range(Slant) of an assigned 2D feature is greater than Threshold Circulation Radius Range. (See description for CIRCULATION RADIUS RANGE.)

Increasing this parameter will allow highly tilted circulations to be identified. The distance between two consecutive 2D features is a function of both vortex tilt and vortex translation between elevation angles. Also, the distance between two consecutive 2D features may become quite large at larger ranges due to spreading of the radar beam, and artificial shifting of azimuthal shear by improper velocity dealiasing.

Small values may limit the algorithm's ability to fully construct 3D features. Large values may result in a higher false alarm rate by associating unrelated and/or false circulation signatures.

The Circulation Radius 2 parameter is not modifiable by the URC.

CIRCULATION RADIUS RANGE

The Range (Slant) beyond which Threshold Circulation Radius 2 is invoked, otherwise Threshold Circulation Radius 1 is used. (See descriptions for CIRCULATION RADIUS 1 and CIRCULATION RADIUS 2.) A large circulation radius is used beyond this range to account for beam broadening

It may be deemed necessary to increase or decrease the value to invoke Threshold Circulation Radius 2 or Threshold Circulation Radius 1. (See descriptions for CIRCULATION RADIUS 1 and CIRCULATION RADIUS 2.) Small / large values may limit the algorithm's ability to fully construct 3D features or liberally construct 3D features near to / far from the RDA.

The Circulation Radius Range parameter is not modifiable by the URC.

MAXIMUM NUMBER 2D FEATURES

Maximum number of 2D Features the algorithm can process per volume scan. This parameter permits the detection of more or fewer 2D features component. Too few 2D features may cause the algorithm to miss important circulations. Too many 2D features may cause CPU loadshedding.

The Maximum Number of 2D Features parameter is not modifiable by the URC.

MIN # OF 2D FEATURES / 3D FEATURE

Minimum number of 2D features needed to make a 3D feature. Defines the fewest number of 2D features required to correlate into a 3D feature. A lower value may increase the probability of detection at greater ranges (especially shallow circulations at ranges greater than or equal to 80 km). However, a lower value may also result in a higher false alarm rate at near ranges, especially in shear regions clearly not associated with tornadic storms, e.g., sea breezes, gust fronts, ground clutter.

The Minimum Number of 2D features per 3D detection parameter is not modifiable by the URC.

MINIMUM 3D FEATURE DEPTH

Minimum depth required to declare a TVS or an ETVS. Depths of 3D circulations may vary according to expected storm type. Also, studies show that the majority of tornadic circulations meet or exceed 1.5 km depth. However, the operator may want to lower this value in cases of very low topped tornadic convection. Large values may result in a lower probability of detection. Small values may result in an increased number of false detections.

The Minimum 3D Feature Depth parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (LLDV and MLDV) that define the meteorologically classified adaptable parameter sets, Default Set, Minimized Set, Squall Line Set, and Tropical Cyclone Set). See adaptable parameter sets defined in section 6.14.1.4 Adaptable Parameter Sets.

MIN 3D FEAT LOW-LVL DELTA VEL

Minimum radial velocity difference in the lowest 2D feature within a 3D feature required to identify a TVS or ETVS. Allows freedom to consider weaker circulations or consider only the stronger circulations based upon expected type of events (e.g. supercells, squall line, bow-echo, etc.). Lower values allow the detection of tornadic circulations in their incipient stages. Additionally, lower values will allow weaker circulations to be processed, however, this could result in a higher false alarm rate.

The Minimum 3D Low-Level Delta Velocity parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (MLDV and depth) that define the meteorologically classified adaptable parameter sets (i.e. Default Set, Minimized Set, Squall Line Set, and Tropical Cyclone Set). See adaptable parameter sets defined in section 6.14.1.4 Adaptable Parameter Sets.

MINIMUM TVS DELTA VELOCITY

Minimum radial velocity difference of the maximum 3D Feature delta velocity required to declare a TVS. See MIN 3D FEAT LOW-LVL DELTA VEL.

The Minimum TVS Delta Velocity parameter is modifiable by the URC; however, the value used can only be used in specific combination with the other adaptable parameters (LLDV and depth) that define the meteorologically classified adaptable parameter sets, Default Set, Minimized Set, Squall Line Set, and Tropical Cyclone Set). See adaptable parameter sets defined in section 6.14.1.4 Adaptable Parameter Sets.

MAXIMUM NUMBER OF 3D FEATURES

Maximum number of 3D Features the algorithm can process per volume scan. Permits the detection of more or fewer 3D Features. Setting this number too low may cause the algorithm to miss important circulations.

The Maximum Number of 3D Features parameter is not modifiable by the URC.

MAXIMUM NUMBER OF TVSs

Maximum number of TVS's the algorithm can process per volume scan. Permits the detection of more or fewer TVSs. Setting this number too low may cause the algorithm to miss important circulations.

The Maximum Number of TVSs parameter is not modifiable by the URC.

MAXIMUM NUMBER OF ELEVATED TVSs

Maximum number of elevated TVS's the algorithm can process per volume scan. This parameter permits the detection of more or fewer elevated TVSs. With a default value of 0, this parameter stops TDA from identifying ETVSs and the placement of ETVS detections on the Combined Attribute Table. If users decide to generate ETVSs, with a value greater than 0, ETVSs will be placed in the Combined Attribute Table and NIDS users will receive ETVS information. If ETVSs are generated at the RPG, users will have to change an adaptable parameter on the PUP, Display ETVSs Yes or No, from a default value of No to a value of Yes to display the ETVS detections on the PUP screen.

The Maximum Number of ETVs parameter is modifiable by the URC.

MINIMUM TVS BASE HEIGHT

Minimum height AGL to which the base of a 3D Feature must extend to be declared a TVS. Used in conjunction with Minimum TVS Base Elevation. (See description MINIMUM TVS BASE ELEVATION.)

TVS detections at near ranges may not extend to the lowest elevation angle, yet are very close to the ground. This parameter allows these circulations to be identified as TVSs. Large values may limit the ability to detect of tornadic circulations. The false alarm rate may increase with an increase in MINIMUM TVS BASE HEIGHT.

The Minimum TVS Base Height parameter is not modifiable by the URC.

MINIMUM TVS BASE ELEVATION

Lowest elevation angle to which the base of a 3D Feature must extend to declare a TVS unless the circulation extends to or below Minimum TVS Base Height (See description for MINIMUM TVS BASE HEIGHT). Three dimensional circulations which do not extend to the prescribed lowest elevation angle are declared ETVSs.

At close ranges, circulations are often detected first at higher elevation angles. However, increasing the MINIMUM TVS BASE ELEVATION may also increase the false alarm rate.

The Minimum TVS Base Elevation parameter is not modifiable by the URC.

MIN AVG DELTA VEL HEIGHT

Minimum height below which all 2D Features comprising a 3D Feature are assigned an equal weighting of 1 in the calculation of average delta velocity of the entire 3D Feature.

Thus, this parameter gives more weight to more lower tilts in the calculation of average delta velocity of the entire 3D Feature. Increasing MIN AVG DELTA VEL HEIGHT will increase the depth over which 2D Features contribute equally to the calculation of average delta velocity of the entire 3D Feature.

The Minimum Average Delta Velocity Height is not modifiable by the URC.

MAXIMUM STORM ASSOCIATION DISTANCE

Maximum distance from a storm within which to associate TVS and ETVS detections with storm cell detections. Association is not required to declare a TVS or ETVS detection.

The number and type of expected storms may change on a daily basis and from region to region. Smaller values may result in not associating an identified TVS/ETVS with a storm.

The failure to associate a TVS/ETVS with a storm has **NO** impact on detection of tornadic circulations. However, a TVS/ETVS not associated with a storm cell will not be displayed in the Combined Attributes Table (of the Composite Reflectivity product).

The Maximum Storm Association Distance parameter is not modifiable by the URC.

6.14.3 Additional Reference Material

For additional information refer to the following material:

Build 10 Precursor Training Booklet.

Lee and Mitchell, 1999: Performance of the WSR-88D build 10 tornado detection algorithm: Development of optimal adaptable parameter sets. Submitted to the *15th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology*, In Press.

Mitchell E.D., M.A., Fresch, R,R, Lee, T.M. Smith, W.D. Zittel, 1998: The new NSSL tornado detection algorithm for the WSR-88D. Preprints, *14th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology,* Phoenix AZ, Amer. Meteor. Soc., 271 - 274.

Mitchell E.D., S.V. Vasiloff, G.J. Stumpf, A. Witt, M.D. Eilts, J.T. Johnson, K.W. Thomas, 1988: The National Severe Storms Laboratory tornado detection algorithm. *Weather and Forecasting*, Vol. 13, No. 2, pp.352 - 366.

Mitchell E.D., 1997: A Performance Evaluation in Comparison of the NSSL Tornado Detection Algorithm and the WSR-88D Tornadic Vortex Signature Algorithm, Preprints, *28th Conf. on Radar Meteorology*, Austin TX, Amer. Meteor. Soc., 351 - 352.

6.15 Velocity Azimuth Display (VAD)

Three adaptable parameters under the URC LOCA allow local modification of the VAD algorithm. The beginning azimuth (TBZ) and ending azimuth (TEZ) parameters enable the local site to define a partial circle from which to collect data. This allows the site to restrict data collection over areas where residual clutter may severely bias the velocity estimate (e.g., a ridge line, area of tall buildings, etc.,). The third parameter, VAD (analysis) range (VAD), defines the optimal slant range to collect velocity samples. This parameter should be modified to ensure adequate velocity samples are available for analysis. For example, on a cold, clear, dry day you may have to decrease the VAD (slant) range to enable the radar to collect enough samples to perform the VAD analysis. On the other hand, on a muggy, summer day you might increase the VAD (slant) range to negate the effects of residual ground clutter near the radar.

```
                                      VAD                            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,VA,
FEEDBACK:                                                             OPER A/

     (M)odify  (E)nd  (C)ancel

ITEM              VAD    TBZ    TEZ    THV    THY   FT    NPTS

---------------------------------------------------------------------------
CURRENT           30.0    0.0    0.0   5.0    7.0    2      25
---------------------------------------------------------------------------
MIN                1.0    0.0    0.0   0.0    0.0    1       1
MAX              230.0  359.9  359.9  15.0   20.0    5     360

Definition                          Units Definition                     Units
VAD - VAD Range                        km NPTS - Minimum number samples      -
TBZ - Threshold (Beginning Azimuth)   deg
TEZ - Threshold (Ending Azimuth)      deg
THV - Threshold (Velocity)            m/s
THY - Threshold (Symmetry)            m/s
FT  - Number of Fit Tests               -
```

Figure 6.15-1

6.16 Vertically Integrated Liquid Water (VIL)

This menu allows the VIL parameters to be modified.

```
                                      VIL                            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,VI,
FEEDBACK:                                                             OPER A/

     (M)odify  (E)nd  (C)ancel

ITEM              BW    MRT   MVT

---------------------------------------------------------------------------
CURRENT          1.00   18.3   80
---------------------------------------------------------------------------
MIN              0.50  -33.0    1
MAX              2.00   94.0  200

Definition                     Units
BW  - Beam Width                deg
MRT - Min Ref Threshold         dBZ
MVT - Max VIL Threshold        Kg/m2
```

Figure 6.16-1

6.17 Z -R Coefficients - Delegated URC Authority

The Z-R Coefficients (**CZM** and **CZP**) define the relationship the PPS uses to convert from reflectivity to estimated rainfall rate as shown in the following equation:

$$\mathbf{Z = (CZM)} \times R^{(CZP)}$$

The default values for **CZM** (300) and **CZP** (1.4) are considered to be very representative in normal convective rain events.

6.17.1 Delegated Authority Restrictions

Our studies and numerous reports from the field have concluded that the default Z-R Coefficients may cause significant underestimation of precipitation in tropical, warm convective rain events, such as hurricanes and tropical storms. The OSF has authorized sites along the Gulf of Mexico and Atlantic Coasts to use a tropical Z-R relationship (**Z = 250R**$^{(1.2)}$) during these tropical events.

6.17.2 Supplemental Information

To invoke the tropical Z-R relationship change the **CZM** to 250 and **CZP** to 1.2.

```
                                Z R COEFFICIENTS                   PAGE  1 OF  1
COMMAND: AD,*****,M,*****,Z,
FEEDBACK:                                                           OPER A/

     (M)odify  (E)nd  (C)ancel


ITEM           CZM    CZP

---------------------------
CURRENT        300    1.4
---------------------------
MIN             30    1.0
MAX           3000    2.5


Definition                            Units
CZM - Multiplicative Z-R  Coefficient  NA
CZP - Power Z-R Coefficient            NA
```

Figure 6.17-1